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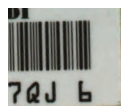
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S. STEAMBOAT-INSPECTION  
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GENERAL RULES

1911

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DEPARTMENT OF COMMERCE AND LABOR  
STEAMBOAT-INSPECTION SERVICE

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steamboats GENERAL RULES AND REGULATIONS

PRESCRIBED BY THE

BOARD OF SUPERVISING INSPECTORS "

AS AMENDED

JANUARY, 1911

AND AS FURTHER AMENDED BY ACTION OF EXECUTIVE COMMITTEE OF THE  
BOARD OF SUPERVISING INSPECTORS, APRIL, MAY, AND JUNE, 1911

AMENDMENTS APPROVED BY THE SECRETARY OF COMMERCE AND LABOR

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*Edition: July 25, 1911*



WASHINGTON  
GOVERNMENT PRINTING OFFICE  
1911





## AMENDMENTS OF STEAMBOAT-INSPECTION RULES AND REGULATIONS.

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DEPARTMENT OF COMMERCE AND LABOR,  
OFFICE OF THE SECRETARY,  
Washington, July 25, 1911.

*To United States supervising and local inspectors, Steamboat-Inspection Service, chief officers of customs, and others concerned:*

Under the provisions of section 4405, Revised Statutes of the United States, as amended by an act of Congress approved March 3, 1905, the executive committee of the Board of Supervising Inspectors, at called meetings held on April 20, May 31, and June 27 to 29, inclusive, 1911, amended the following-named sections of the General Rules and Regulations: Sections 1 and 4, Rule I; 19 and 23, Rule II; 2 and 22, Rule III; 13, Rule IV; 9, Rule V; and 10, Rule IX. These amendments are included in the present edition of the General Rules and Regulations.

The executive committee at the meeting of June 27 to 29, inclusive, 1911, approved the following-named devices for use on vessels: The Gaertner boat-releasing hook, presented by R. A. Gaertner, Seattle, Wash; the Ever Ready electric horn, for use on motor boats, presented by the American Ever Ready Co., New York, N. Y.

After a practical demonstration in extinguishing burning gasoline, the following-named fire extinguishers were approved for use on steam vessels as having a capacity for extinguishing burning gasoline: Alert, Babcock No. 1 (6 gallons), Bonner (6 gallons), Childs, Ever Ready (18 gallons), Gold Medal No. 1, Hayward, Keystone, Paragon, Protector, Royal, Safety, Salvage, Stempel, Success, and Underwriters No. 6.

These amendments to the rules and approval of equipments were approved by the Secretary of Commerce and Labor, under the provisions of sections 4405 and 4491, Revised Statutes.

CHARLES NAGEL, *Secretary.*

(3)

975922



## OFFICERS OF THE STEAMBOAT-INSPECTION SERVICE.<sup>1</sup>

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GEO. UHLER, *Supervising Inspector General*,  
DICKERSON N. HOOVER, Jr., *Chief Clerk*,  
Washington, D. C.

---

### SUPERVISING INSPECTORS.

*First district.*—John Bermingham, San Francisco, Cal.

*Second district.*—Henry M. Seeley, New York, N. Y.

*Third district.*—John W. Oast, Norfolk, Va.

*Fourth district.*—Joseph J. Dunn, St. Louis, Mo.

*Fifth district.*—John D. Sloane, Boston, Mass.

*Sixth district.*—Eugene L. Dorsey, Louisville, Ky.

*Seventh district.*—Daniel J. Dougherty, Pittsburg, Pa.

*Eighth district.*—Charles H. Westcott, Detroit, Mich.

*Ninth district.*—James Stone, Cleveland, Ohio.

*Tenth district.*—John A. Cotter, New Orleans, La.

### TERRITORY EMBRACED IN SUPERVISING DISTRICTS.

FIRST DISTRICT embraces all waters and rivers of the United States west of the Rocky Mountains, and the Hawaiian Islands.

SECOND DISTRICT embraces all the waters of Long Island Sound west of the Connecticut River and the tributaries thereto, that portion of Long Island lying west of Riverhead, and the waters of the Atlantic coast, rivers, and tributaries from Long Island to Cape Charles.

THIRD DISTRICT embraces the waters of the Atlantic coast, rivers, and tributaries between Cape Charles and Cape Sable.

FOURTH DISTRICT embraces the Mississippi River and tributaries from above Greenfield, Mo., to the head of navigation on the Missouri River, and to the head of navigation on the Illinois River.

FIFTH DISTRICT embraces the waters of the Atlantic coast, rivers, and tributaries from the eastern boundary of the United States to and including the Connecticut River, and that portion of Long Island east of and including Riverhead.

SIXTH DISTRICT embraces the Ohio River and tributaries up to and including Carrollton, Ky., and the Mississippi River and tributaries from Greenville, Miss., up to and including Greenfield, Mo.

SEVENTH DISTRICT embraces the Ohio River and tributaries above Carrollton, Ky.

EIGHTH DISTRICT embraces all the waters of the Great Lakes north and west of Lake Erie with their tributaries.

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<sup>1</sup> List of officers and clerks corrected to September 5, 1911.



NINTH DISTRICT embraces all the waters of the River St. Lawrence, Lakes Erie, Ontario, and Champlain, and their tributaries.

TENTH DISTRICT embraces the coast and tributary waters of the Gulf of Mexico, between Cape Sable and the mouth of the Rio Grande, and the Mississippi River and tributaries to Greenville, Miss., and Porto Rico.

LOCAL INSPECTORS.

District.	Port.	Of hulls.	Of boilers.
FIRST.....	San Francisco, Cal....	O. F. Bolles.....	John K. Bulger.
	do.....	Cecil Brown, assistant.	John E. Wynn, assistant.
	do.....	James Guthrie, assistant.	Joseph P. Dolan, assistant.
	do.....	Frank H. Turner, assistant.	John B. Wolters, assistant.
	do.....	John N. Ansell, assistant.	George W. Quinn, assistant.
	Portland, Oreg.....	Edward S. Edwards.	Geo. F. Fuller.
	Seattle, Wash.....	Bion B. Whitney.	Robert A. Turner.
	do.....	Evan Griffiths, assistant.	Harry C. Lord, assistant.
	do.....	Charles F. Herriman, assistant.	Thomas J. Young, assistant.
	do.....	Henry S. Smith, assistant.	Thomas Short, assistant.
	do.....	Donald S. Ames, assistant <sup>1</sup> .	George Q. Weldin, assistant. <sup>1</sup>
	Juneau, Alaska.....	Geo. H. Whitney.	Frank H. Newhall.
	St. Michael, Alaska.	Thomas P. Deering.	Carl F. Lehnars.
	Honolulu, Hawaii.	William Howe.	Thomas J. Heeney.
	New York, N. Y.....	Geo. T. Charlton.	John L. Crone.
SECOND.....	do.....	Edward Keane, assistant.	Wm. G. Fenwick, assistant.
	do.....	Frank J. Smith, assistant.	Wm. H. Powers, assistant.
	do.....	Charles M. Bunce, assistant.	Richard F. Wilson, assistant.
	do.....	Thos. H. Foster, assistant.	John E. Wilson, assistant.
	do.....	Joseph Watkinson, assistant.	John W. Fleming, assistant.
	do.....	William Norman, assistant.	John J. McCarthy, assistant.
	do.....	Henry Wellman, assistant.	John Wright, assistant.
	do.....	Cornelius H. Smith, assistant.	John E. Gunn, assistant.
	do.....	Everett J. Millikin, assistant.	Jesse O. Arkebauer, assistant.
	do.....	H. McG. Taylor, assistant.	Alfred G. Knights, assistant.
	do.....	Hector R. Campbell, assistant.	Frank C. Williams, assistant.
	do.....	Alan S. Johnstone, assistant.	Frederick M. Jennings, assistant.
	do.....	Humphrey Jones, assistant.	John B. Hayward, assistant. <sup>2</sup>
	do.....	do.....	Edward G. Allen, assistant. <sup>2</sup>
	Philadelphia, Pa.....	Redford A. Sargent.	David H. Howard.
THIRD.....	do.....	Harry S. Miller, assistant.	Samuel A. Mills, assistant.
	do.....	Hannon M. Power, assistant.	Wilfred Dougherty, assistant.
	do.....	Hugh MacPherson, assistant.	Clement A. Matison, assistant.
	do.....	Peter C. Rickmers, assistant.	Joseph N. J. Seltzer, assistant.
	Albany, N. Y.....	Robert B. Keller.	Andrew Gaul.
	New Haven, Conn.....	Victor E. Wright.	Frederick L. Dennis.
	Norfolk, Va.....	Robert E. Tapley.	Edward W. Bray.
	do.....	Alexander Calcott, assistant.	Thomas J. Hanlon, assistant.
	do.....	John F. Blain, assistant.	Henry L. Simpson, assistant.
	Baltimore, Md.....	Chas. W. Wright.	Edwin F. White.
	do.....	Richard A. Dunn, assistant.	Michael Stanton, assistant.
	do.....	August E. Blom, assistant.	David C. Young, assistant.
	do.....	Paul H. Tyler, assistant.	John Milne, assistant.
	Charleston, S. C.....	Frederick B. Rice.	Joseph K. Cotton.
	Savannah, Ga.....	Wm. G. Lee.	Edward B. Fitzgerald.
FOURTH.....	Jacksonville, Fla.....	William J. Phelan.	Chas. A. Spencer.
	St. Louis, Mo.....	Archibald Gordon.	Wm. J. Macdonald.
FIFTH.....	Dubuque, Iowa.....	George B. Knapp.	James I. Cary.
	Boston, Mass.....	Wm. A. Carleton.	Andrew J. Savage.
SIXTH.....	do.....	Oscar G. Haines, assistant.	Wm. M. Gilman, assistant.
	do.....	Ernest D. Sproul, assistant <sup>4</sup> .	Frank L. Goudey, assistant.
	do.....	Frank C. Lane, assistant.	Albert R. Jackson, assistant. <sup>4</sup>
	New London, Conn.....	Wm. E. Withey.	John Stewart.
	Portland, Me.....	Henry L. Thompson.	John H. Trevett.
	Providence, R. I.....	George F. Waite.	Chas. A. Potter.
	Bangor, Me.....	Chas. O. Cousins.	Walter L. Blaisdell.
	Louisville, Ky.....	John E. Abraham.	George R. Bower.
	Evansville, Ind.....	Richard H. Williams.	Charles T. Greenwood.
	Nashville, Tenn.....	George M. Green.	Joe M. St. John.
	Memphis, Tenn.....	William J. Hodge.	Henry C. Waltz.
	Pittsburg, Pa.....	Isaac B. Williams.	Charles G. Thomas.
	Cincinnati, Ohio.....	John K. Peyton.	George W. Dameron.
	Point Pleasant, W. Va.	Wm. H. Clark.	James W. Kidney.
	Detroit, Mich.....	Frederick J. Meno.	George M. Milne.
EIGHTH.....	Chicago, Ill.....	Ira B. Mansfield.	Roy L. Peck.
	Grand Haven, Mich.....	Robert Reid.	Charles C. Eckliff.
	Marquette, Mich.....	Charles M. York.	Charles M. Gooding.

<sup>1</sup> Detailed to Portland, Oreg.

<sup>2</sup> Detailed to Pittsburg, Pa.

<sup>3</sup> Detailed to Coatesville, Pa.

<sup>4</sup> Detailed to Providence, R. I.

## LOCAL INSPECTORS—Continued.

District.	Port.	Of hulls.	Of boilers.
EIGHTH—(Con.)	Milwaukee, Wis.....	Frank W. Van Patten.....	William A. Collins.
	do.....	Thos. W. Swift, assistant.....	Perry N. Knaggs, assistant.
	do.....	John F. Hansen, assistant <sup>1</sup> .....	John T. Farnham, assistant. <sup>1</sup>
	do.....	Gustav E. Atkinson, assistant <sup>2</sup> .....	William Nicholas, assistant. <sup>2</sup>
	do.....	Samuel Thurston, assistant <sup>2</sup> .....	George Purvis, assistant. <sup>2</sup>
NINTH.....	Port Huron, Mich.....	Willis W. Stewart.....	Frank Van Liew.
	Duluth, Minn.....	John Monaghan.....	Michael F. Chalk.
	Cleveland, Ohio.....	Nils B. Nelson.....	James McGrath.
	Buffalo, N. Y.....	Frederick L. R. Pope.....	Wm. P. Nolan.
	do.....	James M. Todd, assistant.....	Robert Noone, assistant.
TENTH.....	do.....	Thomas W. Gould, assistant <sup>4</sup> .....	Silas H. Hunter, assistant. <sup>4</sup>
	Burlington, Vt.....	W. Warren Rockwell.....	Andrew I. Goodhue.
	Oswego, N. Y.....	Charles A. Potter.....	Robert Chestnut.
	Toledo, Ohio.....	Henry C. McCallum.....	Wm. F. Plietz.
	New Orleans, La.....	Benjamin F. Kelly.....	Cecil N. Bean.
	do.....	Robert J. McBride, assistant.....	Peter J. Dromgool, assistant.
	do.....	Henry O. Lueders, assistant.....	Robert F. Hall, assistant.
	Apalachicola, Fla.....	George H. Whiteside.....	Alton Pierce.
	Galveston, Tex.....	John Leech.....	Felix Smith.
	Mobile, Ala.....	Samuel Taylor.....	Eugene O'Brien.
	San Juan, P. R.....	Wm. K. Martin.....	Harold F. Bean.

<sup>1</sup> Detailed to Detroit, Mich.<sup>2</sup> Detailed to Chicago, Ill.<sup>3</sup> Detailed to Grand Haven, Mich.<sup>4</sup> Detailed to Cleveland, Ohio.*Clerk to Supervising Inspector, Second District.*

Walter Richards, New York, N. Y.

*Clerks to local boards.*

Thomas R. Craigie, San Francisco, Cal.  
 Hugo Hauser, San Francisco, Cal.  
 Ambrose A. Clarke, San Francisco, Cal.  
 Arthur F. Merrill, Portland, Oreg.  
 Willis H. Rooks, Seattle, Wash.  
 Wesley E. Walker, Seattle, Wash.  
 Robert C. Hurley, Juneau, Alaska.  
 Jerome A. Desio, St. Michael, Alaska.  
 James J. Sullivan, Honolulu, Hawaii.  
 Frank J. Dunlea, New York, N. Y.  
 William H. Geoghan, New York, N. Y.  
 Frederick J. de Moll, New York, N. Y.  
 Thomas B. Martin, New York, N. Y.  
 William C. Osborne, New York, N. Y.  
 Max Rolnik, New York, N. Y.  
 Garrett F. Malloy, New York, N. Y.  
 Harold Schum, New York, N. Y.  
 James E. Gallagher, Philadelphia, Pa.  
 William E. McFarland, Philadelphia, Pa.  
 Chas. W. Loux, Philadelphia, Pa.  
 Thomas J. Reilly, Albany, N. Y.  
 John S. Conway, New Haven, Conn.  
 George M. Kitzmiller, Norfolk, Va.  
 Wm. G. Collings, Norfolk, Va.  
 Chas. L. Wiegand, Baltimore, Md.  
 George B. Sprow, jr., <sup>1</sup> Baltimore, Md.  
 George E. Meddaugh, Baltimore, Md.  
 Harry F. Kabernagel, Charleston, S. C.  
 George A. Gregory, Savannah, Ga.  
 Henry R. Maxey, Jacksonville, Fla.  
 Henry E. Folluo, St. Louis, Mo.  
 Wm. R. Oliver, Dubuque, Iowa.  
 George A. Copeland, Boston, Mass.  
 John M. B. Kelly, Boston, Mass.

John J. J. Halloran, Boston, Mass.  
 John J. McIntee, New London, Conn.  
 Wm. H. O'Brien, Portland, Me.  
 James N. Stover, Providence, R. I.  
 Edward L. Sullivan, Providence, R. I.  
 Horace N. Woodruff, Bangor, Me.  
 Arley R. Kimmerling, Louisville, Ky.  
 Emory F. Kohlmeier, Evansville, Ind.  
 Ozro W. Brumfiel, Nashville, Tenn.  
 Harry A. Harrington, Memphis, Tenn.  
 Victor M. Grubb, Pittsburg, Pa.  
 Henry Lindsay, Pittsburg, Pa.  
 Augustus W. Snyder, Cincinnati, Ohio.  
 William E. Monroe, Point Pleasant, W. Va.  
 Alfred J. Doyle, Detroit, Mich.  
 Arthur E. Schutt, Chicago, Ill.  
 Elmer C. Hurless, Grand Haven, Mich.  
 Elmer H. Beckett, Marquette, Mich.  
 Lee R. Whitney, Milwaukee, Wis.  
 David McCarron, Port Huron, Mich.  
 Donald McLennan, Duluth, Minn.  
 Edward Lawlor, Cleveland, Ohio.  
 John E. Mulroy, Buffalo, N. Y.  
 Harold R. Bassett, Buffalo, N. Y.  
 Willis E. Monty, Burlington, Vt.  
 Charles F. Hager, Oswego, N. Y.  
 Edward M. Mansuy, Toledo, Ohio.  
 George J. West, New Orleans, La.  
 Frederick F. Gensler, New Orleans, La.  
 Wm. J. Glasgow, Apalachicola, Fla.  
 Ben L. Read, Galveston, Tex.  
 J. Brooks Clark, Mobile, Ala.  
 Frank S. Miller, San Juan, P. R.

<sup>1</sup> Detailed to Coatesville, Pa.



# GENERAL RULES AND REGULATIONS.

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## STAMPS.

1. Every iron or steel plate intended for the construction or repairs of boilers to be used on steam vessels shall be stamped by the manufacturer in the following manner: § 4431, R. S.

At two diagonal corners, at a distance of about 8 inches from the edges, and at or near the center of the plate, with the name of the manufacturer, place where manufactured, and the number of pounds tensile stress it will bear to the sectional square inch: *Provided*, That on or after July 15, 1911, no iron or steel plate intended for use in the construction or repairs to marine boilers shall be stamped with the tensile strain until after it has been tested by the inspector, and all such iron or steel plates shall then be stamped with the minimum number of pounds tensile strain it will bear to the sectional square inch in accordance with section 4431 of the Revised Statutes: *It is further provided*, That all tested plate in stock at the time of approval of these rules shall be accepted for the tensile strength stamped on such plates at the time of the inspection.

(I)

§ 4430, R. S.

2. Boilers built since February 28, 1872, of material stamped and tested according to the requirements of section 4430, Revised Statutes, and having a record thereof in the office of the local inspectors in the district where the boiler was built or intended to be used, may be used for marine purposes, notwithstanding that such boilers may have been used for other purposes: *Provided*, That in the judgment of the local inspectors they are deemed safe for the purpose.

( § 4431, R. S.

3. If the plates possess the physical, chemical, and other lawful qualities required by these rules, the inspector making the test shall stamp the plate near the manufacturer's stamp, with the official stamp of the United States Steamboat-Inspection Service, and with the initials of his name and a serial number.

Plates may be tested and inspected at the mills for repairs to marine boilers or to be carried in stock, the report of such test to be in duplicate, one copy to be furnished through the supervising inspector to the local inspectors in the district where the purchaser of such material is located, and the other to the purchaser, who shall deliver a copy of the same to the parties using the material, who, in turn, shall submit the same to the local inspectors in the district where the material is to be used, before being assembled in the boiler. Steamers carrying such repair material to be used in emergencies shall carry the record of each sheet of such material on board.

## TESTING.

§§ 4430, 4431,  
R. S.

4. After June 30, 1910, every iron or steel plate subject to tensile strain, to be used in the construction or repairs of boilers for steamers subject to the provisions of Title LII, shall be inspected and tested by an inspector duly authorized under the provisions of said title, as follows:

All material must be free from laminations, cracks, scabs, or other defects tending to reduce its strength.

All plates which show defects in these or other respects shall be rejected.

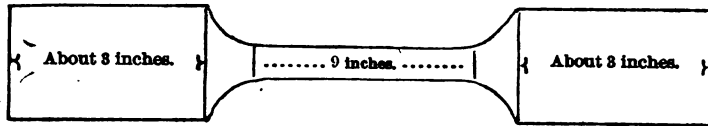
From each plate as first rolled from the billet, bloom, or ingot there shall be taken four test pieces, two for the tensile test from diagonal corners and the other two for the bending test from the other diagonal corners, as hereinafter described.

All the pieces shall be prepared so that the skin shall not be removed, the edges only planed or shaped.

(I, 4)

In no case shall test pieces be prepared by annealing or reduced in size by hammering.

Tensile-test pieces shall be at least 16 inches in length, from  $1\frac{1}{2}$  to  $3\frac{1}{2}$  inches in width at the ends, which ends shall join by an easy fillet, a straight part in the center of at least 9 inches in length and from 1 to  $1\frac{1}{2}$  inches in width, in form according to the following diagram, marked with light prick punch marks at distances 1 inch apart, spaced so as to give 8 inches in length: *Provided, however,* That where samples are tested on the testing machines of the Steamboat-Inspection Service the test pieces shall not have a greater width on the ends than 2 inches, and shall be 1 inch wide in the straight part in the center.



#### STEEL PLATES.

5. Only steel plates manufactured by what is known as the basic or acid open-hearth processes will be allowed to be used in the construction or repairs of boilers for marine purposes, and the manufacturer shall furnish a certificate with each order of steel tested, stating the technical process by which said steel was manufactured. This is not intended to apply to plates used in the construction of Bessemer steel tubes. § 4430, R. S.

No plate made by the acid or basic process shall contain more than .04 per cent of phosphorus and .04 per cent of sulphur, to be determined by analysis by the manufacturers, verified by them, and a copy furnished the inspector for each order tested; which analysis shall, if deemed expedient by the Supervising Inspector General, be verified by an outside test at the expense of the manufacturer of the plate.

For steel plates the sample must show, when tested, an elongation of at least 25 per cent in a length of 4 inches for thickness up to one-fourth inch, inclusive; in a length of 6 inches, for all plates over one-fourth inch. The sample must also show an average reduction of sectional area as follows: At least 50 per cent for thicknesses up to and including one-half inch, 45 per cent for thicknesses over one-half to three-fourths inch, inclusive, and 40 per cent for thicknesses over three-fourths of an inch.

*Quenching and bending test.*—Quenching and bending test pieces shall be at least 12 inches in length and from 1 to  $3\frac{1}{2}$  inches in width. The sides where sheared or planed must not be rounded, but the edges may have the sharpness taken off with a fine file. The test piece shall be

- (I, 5) heated to a cherry red (as seen in a dark place) and then plunged into water at a temperature of about 82° F. Thus prepared, the sample shall be bent to a curve, the inner radius of which is not greater than one and one-half times the thickness of the sample, without cracks or flaws. The ends must be parallel after bending.

#### IRON PLATES.

§ 4403, R. S.

6. Samples from iron plate intended for use in the construction or repairs to marine boilers shall show an elongation of at least 15 per cent in a length of 8 inches.

The sample must also show a reduction of area as follows:

For samples showing 45,000 pounds tensile strength, 15 per cent, and for each additional 1,000 pounds tensile strength up to 55,000 pounds add 1 per cent.

For samples over 55,000 pounds to 60,000 pounds tensile strength, 25 per cent only will be required.

*Bending test.*—Bending test pieces shall be at least 12 inches in length and from 1 to 3½ inches in width. The sides where sheared or planed must not be rounded, but the edges may have the sharpness taken off with a fine file.

Thus prepared, the sample shall be bent cold to an angle of 90° to a curve, the inner radius of which is not greater than one and one-half times the thickness of the sample, without cracks or flaws.

#### RECORD OF TESTS.

§ 4405, R. S.

7. All tests made of boiler material must be recorded upon a table of the following form:

*Tensile tests of samples of material intended to be employed in the construction of boilers of steam vessels made on ——— testing machine.*

Date when tests were made.	From whom samples were obtained.	By whom tested.	Material, iron or steel.	Stamp or label on samples, which must be the same as stamps on the materials from which they are taken.	Numbers on plate.	Widths of samples, expressed in decimals of an inch.	Thickness of samples, expressed in decimals of an inch.	Strain at which each sample parted.	Reduced width of sample.	Reduced thickness of sample.	Reduction of area, per cent.	Length of straight part in center of test piece.	Elongation, percentage of.	Boiler being constructed by—

The gauge to be employed by inspectors to determine the thickness of boiler plates and the widths in the table will be any standard American gauge furnished by the Department of Commerce and Labor.



[Form 935.]

(I, 7)

# **AFFIDAVIT OF MANUFACTURER OF MARINE STEAM BOILERS CONSTRUCTED OF MATERIAL TESTED AT THE MILLS.**

DEPARTMENT OF COMMERCE AND LABOR,  
STEAMBOAT-INSPECTION SERVICE.

STATE OF \_\_\_\_\_, County of \_\_\_\_\_.

On this \_\_\_\_\_ day of \_\_\_\_\_, A. D. 191—, personally appeared before me, \_\_\_\_\_, a notary public in and for the county of \_\_\_\_\_ and State of \_\_\_\_\_, Mr. \_\_\_\_\_, who deposes and says that he is \_\_\_\_\_, of \_\_\_\_\_, boiler manufacturer, and has contracted to build \_\_\_\_\_ marine boiler for \_\_\_\_\_, of \_\_\_\_\_, Plate stamped \_\_\_\_\_ T. S., from \_\_\_\_\_ plate manufactured by \_\_\_\_\_, of \_\_\_\_\_, which plate was tested at the mills by a United States assistant inspector, as provided in the act of Congress approved January 22, 1894, each of said plates having stamped thereon the words "U. S. Assistant Inspector" and the initials —, and numbered as follows: \_\_\_\_\_.

No plate for shell or other part of boiler subject to tensile strain, other than herein specified, will be used in the construction of said boiler, the dimensions of which will be: Length, \_\_\_\_\_; diameter, \_\_\_\_\_. Tubes: Material, \_\_\_\_\_; number of, \_\_\_\_\_; length, \_\_\_\_\_; thickness, \_\_\_\_\_; diameter, \_\_\_\_\_. Flues: Number of, \_\_\_\_\_; length, \_\_\_\_\_; thickness, \_\_\_\_\_; diameter, \_\_\_\_\_. Furnaces: Number of, \_\_\_\_\_; length, \_\_\_\_\_; thickness, \_\_\_\_\_; diameter, \_\_\_\_\_. Kind of furnaces, \_\_\_\_\_; round, \_\_\_\_\_; corrugated, \_\_\_\_\_; flat sides, \_\_\_\_\_. Thickness of plates of cylindrical shell of boiler, \_\_\_\_\_; thickness of side sheets in flat side of furnace, \_\_\_\_\_; thickness of flat top sheet of back connection, \_\_\_\_\_; thickness of plates of cylindrical shell of back connection, \_\_\_\_\_; thickness of material of boiler heads, \_\_\_\_\_; thickness of tube sheets, \_\_\_\_\_; thickness of plates of shell of steam chimney, \_\_\_\_\_; thickness of plates in lining of steam chimney, \_\_\_\_\_; thickness of side sheets, \_\_\_\_\_. Kind of rivets (iron or steel), \_\_\_\_\_; diameter of rivet holes, \_\_\_\_\_; pitch of rivets, \_\_\_\_\_. All rivet holes of boiler, including steam and mud drums, will be fairly drilled and no part of such holes will be punched, \_\_\_\_\_; or punched, \_\_\_\_\_.

All holes for stay bolts and tubes will be fairly drilled and no part punched, \_\_\_\_\_. All tubes used in the construction of said boiler are of the thickness and material required by, and have met all the other requirements of, the rules of the Board of Supervising Inspectors, as shown by statement of the manufacturer of the tubes. Steam pressure for which boiler \_\_\_\_\_ to be inspected, \_\_\_\_\_ pounds. Style of boiler, \_\_\_\_\_. Boiler \_\_\_\_\_ to be installed upon the steamer \_\_\_\_\_.

Signature: \_\_\_\_\_.

Subscribed and \_\_\_\_\_ to before me this \_\_\_\_\_ day of \_\_\_\_\_, 191—.

(Sworn or affirmed.)

[NOTARY'S SEAL.]

\_\_\_\_\_  
Notary Public.

NOTE.—Inspectors will not accept this affidavit without the data required, unless accompanied by a satisfactory explanation in writing, to be filed with the affidavit.

(I, 7)

[Form 936.]

**AFFIDAVIT OF MANUFACTURER OF MARINE STEAM BOILERS.**DEPARTMENT OF COMMERCE AND LABOR,  
STEAMBOAT-INSPECTION SERVICE.

STATE OF ———, County of ———.

§ 4405, R. S.

On this — day of ———, A. D. 191—, personally appeared before me, ———, a notary public in and for the county of ——— and State of ———, Mr. ———, who deposes and says that he is ———, of ———, boiler manufacturer, and that the accompanying samples of ———, manufactured by ———, of ———, were cut from plates stamped ——— T. S., which are to be used in the construction of ——— marine boiler for ———, and no plate for shell or other part of boiler subject to tensile strain of less tensile strength or quality than herein specified will be used in the construction of said boiler, the dimensions of which will be: Length, ———; diameter, ———. Tubes: Material, ———; number of, ———; length, ———; thickness, ———; diameter, ———. Flues: number of, ———; length, ———; thickness, ———; diameter, ———. Furnaces: Number of, ———; length, ———; thickness, ———; diameter, ———. Kind of furnaces, ———; round, ———; corrugated, ———; flat sides, ———. Thickness of plates of cylindrical shell of boiler, ———; thickness of side sheets in flat side of furnace, ———; thickness of flat top sheet of back connection, ———; thickness of plates of cylindrical shell of back connection, ———; thickness of tubesheets, ———; thickness of plates of shell of steam chimney, ———; thickness of plates in lining of steam chimney, ———; thickness of side sheets, ———. Kind of rivets (iron or steel), ———; diameter of rivet holes, ———; pitch of rivets, ———. All rivet holes of boiler including steam and mud drums, will be fairly drilled and no part of such holes will be punched, ———; or punched, ———.

All holes for stay bolts and tubes will be fairly drilled and no part punched, ———. All tubes used in the construction of said boiler are of the thickness and material required by, and have met all the other requirements of, the rules of the Board of Supervising Inspectors, as shown by statement of the manufacturer of the tubes. Steam pressure for which boiler ——— to be inspected, ——— pounds. Style of boiler, ———. Boiler to be installed upon the steamer ———.

Signature: ———.

Subscribed and ——— to before me this ——— day of ———, 191—.

(Sworn or affirmed.)

[NOTARY'S SEAL.]

Notary Public.

NOTE.—Inspectors will not accept this affidavit unless the data required are given unless accompanied by a satisfactory explanation in writing, to be filed with the affidavit.

Inspectors may make requisition on the department for the necessary supply of blank affidavits for the use of boiler manufacturers.

**FOREIGN-BUILT BOILERS.**

§ 4405, R. S.

8. Boilers of foreign-built vessels admitted to American registry shall be deemed, if of iron, to have a tensile strength of 45,000 pounds to the sectional square inch; and, if of steel, to have a tensile strength of 50,000 pounds to the square inch: *Provided, however,* That when the local inspectors of steamboats are furnished with an authentic copy of the tensile tests of the material entering into the construction of such boilers, the boilers shall be inspected and tested in accordance with the rules and regulations of the Board of Supervising Inspectors and

allowed a steam pressure in accordance with the tensile strength of the material and general condition of the boilers. (I, 8)

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1. The manufacturer of any boiler to be used for marine purposes shall furnish the inspectors of the district where such boiler or boilers are to be inspected duplicate blue prints or tracings descriptive of same for their approval, one of which shall be kept on file in the office of the local inspectors and the other returned to the manufacturer. Where more than one boiler is made from a similar design, a drawing of which is on file in the local inspector's office, if made at a different date, a reference to such drawing on file is all that shall be required. The manufacturer shall also furnish the inspectors a written statement of the kind of material and size of rivets to be used in the construction of such boiler, the size and longitudinal and diagonal pitch of the rivet holes in same, and distance from center of rivet holes to edge of plate, as well as the affidavit required by section 9 of Rule I, subscribed to either by himself or authorized agent having superintendence of the construction of such boiler. (II) § 4405, R. S.

#### CYLINDRICAL SHELLS.

2. The working steam pressure allowable on cylindrical shells of boilers constructed of plates inspected as required by these rules, when single riveted, shall not produce a strain to exceed one-sixth of the tensile strength of the iron or steel plates of which such boilers are constructed; but where the longitudinal laps of the cylindrical parts of such boilers are double riveted, and the rivet holes for such boilers have been fairly drilled instead of punched, an addition of 20 per cent to the working pressure provided for single riveting will be allowed. § 4433, R. S.

The pressure for any dimension of boilers must be ascertained by the following rule, viz:

Multiply one-sixth of the lowest tensile strength found stamped on the plates in the cylindrical shell by the thickness—expressed in inches or part of an inch—and divide by the radius or half diameter, also expressed in inches, and the result will be the pressure allowable per square inch of surface for single riveting, to which add 20 per cent where the longitudinal laps of the cylindrical parts of such boiler are double riveted, when all the rivet holes of such boiler, including steam and mud drums, have been fairly drilled and no part of such holes has been punched. The pressure allowed shall be based on the plate whose tensile strength multiplied by its thickness gives the lowest product.

3. Plates of iron or steel, used in the construction of boilers, extending beyond the cylindrical shell to the front of the boiler over the furnaces, shall extend at least 12 inches below the center of the shell, and shall not be of less tensile strength or thickness than the adjoining sheets in the cylindrical portions of the shell, and the sheets forming the shell shall be rolled to form of shell with the grain of the material. § 4418, R. S.

(II) HOLES FOR STAY BOLTS AND TUBES, RIVET HOLES AND BUTT STRAPS.

§§ 4418, 4433, 4. All holes for stay bolts and tubes shall be fairly drilled and no part punched.

The diameter of rivets, rivet holes, distance between centers of rivets, and distance from centers of rivets to edge of lap for different thicknesses of plates for single and double riveting shall be determined by the following rule:

(See Appendix, pp. 121-123.)

5. Where butt straps are used in the construction of marine boilers, the straps for single butt strapping shall in no case be less than the thickness of the shell plates; and where double butt straps are used, the thickness of each shall in no case be less than five-eighths ( $\frac{5}{8}$ ) the thickness of the shell plates.

DRILLING TO DETERMINE THICKNESS.

§ 4430, R. S. 6. Any boiler ten years old or more shall, at the first annual inspection thereafter, be drilled at points near the water line and at bottom of shell of boiler, or such other points as the local inspectors may direct, to determine the thickness of such material at those points; and the steam pressures allowed shall be governed by such ascertained thickness and the general condition of the boiler.

HYDROSTATIC PRESSURE.

§ 4418, R. S. 7. The hydrostatic pressure applied must be in the proportion of 150 pounds to the square inch to 100 pounds to the square inch of the steam pressure allowed, and the inspector, after applying the hydrostatic test, must thoroughly examine every part of the boiler.

In applying the hydrostatic test to boilers with a steam chimney the test gauge should be applied to the water line of such boilers.

DONKEY BOILERS.

§ 4418, R. S. 8. Every seagoing steamer carrying passengers shall be supplied with an auxiliary or donkey boiler of sufficient capacity to work the fire pumps, and such boilers shall not be placed below the lower decks, except on single-deck vessels, on any steamer hereafter built or applying for first inspection as a passenger steamer.

Donkey boilers must be inspected in the same manner as the main boilers.

STAYS.

§§ 4405, 4418, 9. The maximum working pressure in pounds allowable per square inch of cross-sectional area for stays used

in the construction of marine boilers where same are accurately fitted normal to supported surfaces and properly secured shall be ascertained by the following formula: (II, 9)

$$P = \frac{A \times C}{a}$$

Where P = working pressure in pounds.

A = least cross-sectional area of stay in inches.

a = area of surface supported by one stay, in inches.

C = a constant.

C = 9,000 for tested steel stays 1½ inches and upward in diameter when such stays are not forged or welded. The ends may be upset to a sufficient diameter to allow for the depth of the thread. The diameter shall be taken at the bottom of the thread, provided it is the least diameter of the stay. All such stays after being upset shall be thoroughly annealed.

C = 8,000 for a tested Huston or similar type of brace, the cross-sectional area of which exceeds 5 square inches.

C = 7,000 for such tested braces when the cross-sectional area is not less than 1.227 and not more than 5 square inches, provided such braces are prepared at one heat from a solid piece of plate without welds.

C = 7,500 for wrought-iron through stays 1½ inches in diameter and upward. When made of the best quality of refined iron, they may be welded. The ends may be upset to allow for the depth of the thread. The diameter shall be taken at the bottom of the thread, provided it is the least diameter of the stay.

C = 6,000 for welded crowfoot stays when made of best quality of refined wrought iron, and for all stays not otherwise provided for when made of the best quality of refined iron or of steel without welds.

#### EXAMPLE.

Required the working pressure of a stay 1 inch in diameter, pitched 6 inches by 6 inches center to center.

$$\text{Working pressure} = \frac{(1 \times 1 \times .7854) \times 6,000}{6 \times 6} = 130.9 \text{ pounds.}$$



- (II, 9) Stay bolts and stays made of the best quality of refined wrought iron may be welded. The use of welded steel stays of any form is positively prohibited.

TO DETERMINE THE AREAS OF DIAGONAL AND GUSSET STAYS.

Multiply the area of a direct stay required to support the surface by the slant or diagonal length of the stay; divide this product by the length of a line drawn at right angles to surface supported to center of palm of diagonal stay. The quotient will be the required area of the diagonal stay.

$$A = \frac{a \times L}{l}$$

Where A = sectional area of diagonal stay.

a = sectional area of direct stay.

L = length of diagonal stay.

l = length of line drawn at right angles to boiler head or surface supported to center of palm of diagonal stay.

Given diameter of direct stay = 1 inch, a = .7854, L = 60 inches, l = 48 inches, substituting and solving,

$$A = \frac{.7854 \times 60}{48} = .981 \text{ sectional area.}$$

Diameter = 1.11 inch =  $1\frac{1}{8}$  inch.

The sectional area of gusset stays, when constructed of triangular right-angled web plates secured to single or double angle bars along the two sides at right angles, shall be determined by formula for diagonal stays, and shall be not less than 10 per cent greater than would be necessary for a diagonal bolt stay.

The diameter of a screw stay shall be taken at the bottom of the thread, provided it is the least diameter of the stay.

For all stays the least sectional area shall be taken in calculating the stress allowable.

All screw stay bolts shall be drilled at the ends with a one-eighth inch hole to at least a depth of one-half inch beyond the inside surface of the sheet. Stays through laps or butt straps may be drilled with larger hole to a depth so that the inner end of said larger hole shall not be nearer than the thickness of the boiler plates from the inner surface of the boiler.

Such screw stay bolts, with or without sockets, may be used in the construction of marine boilers where fresh water is used for generating steam: *Provided, however,* That screw stay bolts of a greater length than 24 inches will not be allowed in any instance, unless the ends of said bolts are fitted with nuts. Water used from a surface condenser shall be deemed fresh water.

Holes for screw stays must be tapped fair and true, and full thread. (II, 9)

The ends of stays which are upset to include the depth of thread shall be thoroughly annealed after being upset.

The sectional area of pins to resist double shear and bending, accurately fitted and secured in crowfeet, sling, and similar stays, shall be at least equal to eight-tenths of the required sectional area of the brace. Breadth across each side and depth to crown of eye shall be not less than .35 to .55 of diameter of pin. In order to compensate for inaccurate distribution the forks should be proportioned to support two-thirds of the load, thickness of forks to be not less than .66 to .75 of the diameter of pins.

The combined sectional area of rivets used in securing tee irons and crowfeet to shell, said rivets being in tension, shall be not less than the required sectional area of brace. To insure a well-proportioned rivet point, rivets shall be of sufficient length to completely fill the rivet holes and form a head equal in strength to the body of the rivet. All rivet holes shall be drilled. Distance from center of rivet hole to edge of tee irons, crowfeet, and similar fastenings shall be so proportioned that the net sectional areas through sides at rivet holes shall equal the required rivet section. Rivet holes shall be slightly countersunk in order to form a fillet at point and head.

All steel bars used as stays or braces and braces of the Huston type to be allowed a stress of 7,000, 8,000, or 9,000 pounds per square inch of section shall be tested by the inspectors, in lots not to exceed 50 bars, in the following manner: Inspectors shall select one bar or brace from each lot and bend one end of such bar or brace cold to a curve, the inner radius of which is equal to one and one-half times the diameter of the test bars or the thickness of the brace, as the case may be, without flaws or cracks; and should any such test bar or brace fail in the test, the lot from which the test bar or brace was taken shall not be allowed to be used in the construction of marine boilers.

Boiler manufacturers desiring to use tested steel stays or braces shall be required to furnish the inspectors with the following form of affidavit duly filled in:

[Form 937.]

STATE OF ———, County of ———, ss:

Personally appeared before me, a notary public for and in the county of ——— and State of ———, Mr. ———, who, being first duly sworn, deposes and says that he is the ——— of the steam boiler works situated at ———, and known as the ———, and that the lot or lots of steel bars from which the test bars were taken and tested by the inspector on the ——— day of ———, 190—, and allowed for use in the steam boiler— to be constructed for the steamer ———, and to be allowed a strain not to exceed ——— pounds per square inch of section as a working steam pressure, will be used in the construction of the boiler— for the steamer ———, and no material for any braces, stays, or stay bolts required to carry a strain equal to ——— pounds per square inch of

(II, 9)

section will be used as braces, stays, or stay bolts in the construction of the boiler— for the said steamer unless tested by the inspector and approved by him in accordance with the requirements of law.

Sworn to and subscribed before me this — day of —, 190—.   
 [NOTARY'S SEAL.]

Notary Public.

#### TOPS OF COMBUSTION CHAMBERS AND BACK CONNECTIONS.

§ 4418, R. S.

10. Formula for girders over back connection and other flat surfaces:

$$\text{Working pressure} = \frac{C \times d^2 \times T}{(W - P) \times D \times L}$$

Where W = extreme width of combustion box in inches.

P = pitch of supporting bolts in inches.

D = distance between girders from center to center in inches.

L = length of girder in feet.

d = depth of girder in inches.

T = thickness of girder in inches.

C = 550 when the girder is fitted with 1 supporting bolt.

C = 825 when the girder is fitted with 2 or 3 supporting bolts.

C = 917 when the girder is fitted with 4 or 5 supporting bolts.

C = 963 when the girder is fitted with 6 or 7 supporting bolts.

C = 990 when the girder is fitted with 8 or more supporting bolts.

#### EXAMPLE.

Given W = 34 inches, P = 7.5 inches, D = 7.75 inches, L = 2.927 feet, d = 7.5 inches, T = 2 inches, C = 825, then, substituting in formula,

$$\text{Working pressure} = \frac{825 \times 7.5 \times 7.5 \times 2}{(34 - 7.5) \times 7.75 \times 2.927} = 154.3 \text{ pounds.}$$

#### FLAT SURFACES.

§ 4418, R. S.

11. The maximum stress allowable on flat plates supported by stays shall be determined by the following formula:

All stayed surfaces formed to a curve the radius of which is over 21 inches, excepting surfaces otherwise provided for, shall be deemed flat surfaces.

$$\text{Working pressure} = \frac{C \times T^2}{P^2}$$

Where  $T$  = thickness of plates in sixteenths of an inch. (II, 11)

$P$  = greatest pitch of stays in inches.

$C = 112$  for screw stays with riveted heads, plates seven-sixteenths of an inch thick and under.

$C = 120$  for screw stays with riveted heads, plates above seven-sixteenths of an inch thick.

$C = 120$  for screw stays with nuts, plates seven-sixteenths of an inch thick and under.

$C = 125$  for screws stays with nuts, plates above seven-sixteenths of an inch thick and under nine-sixteenths of an inch.

$C = 135$  for screw stays with nuts, plates nine-sixteenths of an inch thick and above.

$C = 175$  for stays with double nuts having one nut on the inside and one nut on the outside of plate, without washers or doubling plates.

$C = 160$  for stays fitted with washers or doubling strips which have a thickness of at least .5 of the thickness of the plate and a diameter of at least .5 of the greatest pitch of the stay, riveted to the outside of the plates, and stays having one nut inside of the plate, and one nut outside of the washer or doubling strip. For  $T$  take 72 per cent of the combined thickness of the plate and washer or plate and doubling strip.

$C = 200$  for stays fitted with doubling plates which have a thickness equal to at least .5 of the thickness of the plate reenforced, and covering the full area braced (up to the curvature of the flange, if any), riveted to either the inside or outside of the plate, and stays having one nut outside and one inside of the plates. Washers or doubling plates to be substantially riveted. For  $T$  take 72 per cent of the combined thickness of the two plates.

$C = 200$  for stays with plates stiffened with tees or angle bars having a thickness of at least two-thirds the thickness of plate and depth of webs at least one-fourth of the greatest pitch of the stays, and substantially riveted on the inside of the plates, and stays having one nut inside bearing on washers fitted to the edges of the webs, that are at right angles to the plate. For  $T$  take 72 per cent of the combined thickness of web and plate.

No such flat plates or surfaces shall be unsupported at a greater distance than 18 inches.

(II, 11)

**EXAMPLE.**

Required the working pressure allowable for plate five-eighths of an inch thick, with doubling plate seven-sixteenths of an inch thick, stayed 14-inch by 14-inch centers:

$$\text{Working pressure} = \frac{200 \times 149.81}{196} = 152 \text{ pounds.}$$

Plates heated for working must be annealed afterwards.

**REQUIREMENTS FOR HEADS.**

§ 4418, R. S.

12. All plates used as heads, when new and made to practically true circles, and as described below, shall be allowed a steam pressure in accordance with the following formula:

**CONVEX HEADS.**

$$P = \frac{T \times S}{R}$$

Where P = steam pressure allowable in pounds.

T = thickness of plate in inches.

S = one-sixth of the tensile strength.

R = one-half of the radius to which the head is bumped.

Add 20 per cent to P when the head is double riveted to the shell and the holes are fairly drilled.

**CONCAVE HEADS.**

For concave heads the pressure allowable will be .6 times the pressure allowable for convex heads.

NOTE.—To find the radius of a sphere of which the bumped head forms a part, square the radius of head, divide this by the height of bump required; to the result add height of bump, which will equal diameter of sphere, one-half of which will be the required radius.

**EXAMPLE.**

Required the working pressure of a convex head of a 54-inch radius, material 60,000 pounds tensile strength and one-half of an inch thick, double riveted and holes fairly drilled. Substituting values, we have

$$P = \frac{.5 \times 10,000}{27} + 20 \text{ per cent} = 185 + 37 = 222 \text{ pounds.}$$

The pressure allowable on a concave head of the same dimensions would be:

$$222 \times .6 = 133 \text{ pounds.}$$

Bumped heads may contain a manhole opening flanged inwardly, when such flange is turned to a depth of three times the thickness of material in the head.

Material used in the construction of all bumped heads (II, 12) shall possess the physical and chemical qualities prescribed by the Board of Supervising Inspectors for all plates subject to tensile strain, as required by section 4430, Revised Statutes.

#### FLAT HEADS OF WROUGHT-IRON OR STEEL PLATE.

Where flat heads do not exceed 20 inches in diameter they may be used without being stayed, and the steam pressure allowable shall be determined by the following formula:

$$P = \frac{C \times T^2}{A}$$

Where P = steam pressure allowable in pounds.

T = thickness of material in sixteenths of an inch.

A = one-half the area of head in inches.

C = 112 for plates seven-sixteenths of an inch and under.

C = 120 for plates over seven-sixteenths of an inch.

*Provided*, The flanges are made to an inside radius of at least  $1\frac{1}{2}$  inches.

#### EXAMPLE.

Required the working pressure of a flat head 20 inches in diameter and three-fourths of an inch thick. Substituting values, we have

$$P = \frac{120 \times 144}{157} = 110 \text{ pounds.}$$

#### TUBES.

13. Lap-welded and seamless tubes, used in boilers  <sup>§§. 4405, 4418, R. S.</sup> whose construction was commenced after June 30, 1910, having a thickness of material according to their respective diameters, shall be allowed a working pressure as prescribed in the following table, provided they are deemed safe by the inspectors. Where heavier material is used, pressure may be allowed as prescribed in formula on page 38. Any length of tube is allowable.

Outside diameter.	Thickness of material.	Maximum pressure allowed.
<i>Inches.</i>	<i>Inch.</i>	<i>Pounds.</i>
2	0.095	427
2½	.095	380
2½	.109	392
2½	.109	356
3	.109	327
3½	.120	332
3½	.120	308
3½	.120	282
4	.134	303
4½	.134	238
5	.148	235
6	.165	199

(II, 13)

## MAIN STEAM PIPE.

The thickness of and pressure allowed on main steam pipe constructed of riveted iron or steel plates that have been stamped and tested as required by section 4430, Revised Statutes, shall be determined in the same manner as required by section 4433, Revised Statutes, to determine the pressure allowable on boilers.

The thickness of and steam pressure allowable on all lap-welded main steam pipe of wrought iron or steel shall be determined by the following formulas:

$$T = \frac{P \times D}{10,000} + .125$$

$$P = \frac{(T - .125) \times 10,000}{D}$$

Where P = pressure of steam allowable in pounds.

T = thickness of pipe.

D = diameter of pipe.

## EXAMPLE.

Given P = 200 pounds pressure. D = 5 inches in diameter. Substituting and solving for T,

$$T = \frac{200 \times 5}{10,000} + .125 = .225 \text{ inch.}$$

Substituting and solving for P,

$$P = \frac{(.225 - .125) \times 10,000}{5} = 200 \text{ pounds.}$$

## LAP-WELDED BOILER TUBES UP TO AND INCLUDING 4 INCHES IN DIAMETER.

All lap-welded tubes shall be made of charcoal iron, or mild steel, made by any process.

## SURFACE INSPECTION.

Tubes shall be free from defective welds, cracks, blisters, scale, pits, and sand marks.

## TESTS.

The following tests shall be made before shipment by the manufacturer:

(a) A test piece 2 inches in length cut from a tube must stand being flattened by hammering until the sides are brought parallel with the curve on the inside at the ends not greater than three times the thickness of the metal without showing cracks or flaws, with bend at one side being in the weld.

(b) A second tube shall have a flange turned over at right angles to the body of the tube and shall have a width equal to three-eighths of an inch.



All the work shall be done cold.

Each tube shall be subjected to an internal hydrostatic pressure of 500 pounds per square inch without showing signs of weakness or defects.

All steel tubes shall have ends properly annealed by the manufacturer before shipment, and must stand expanding, flanging over on the tube plate, and beading without flaw, crack, or opening at weld.

**LAP-WELDED BOILER TUBES OVER 4 INCHES UP TO AND INCLUDING 30 INCHES IN DIAMETER.**

All lap-welded boiler tubes over 4 inches in diameter, up to and including 30 inches in diameter, shall be made of wrought iron or mild steel, made by any process.

(a) A test piece, 2 inches in length, cut from a tube, must stand being flattened by hammering until the sides are brought parallel with the curve on the inside at the ends not greater than three times the thickness of the metal without showing cracks or flaws, with bend at one side in the weld.

Each tube shall be subjected to an internal hydrostatic pressure of 500 pounds per square inch without showing signs of weakness or defects.

All steel tubes shall have ends properly annealed by the manufacturer before shipment. Tubes must stand drilling, riveting, and calking, and work necessary to install them into the tube head without showing any signs of weakness or defects.

No increase in thickness by welding one tube inside of another shall be allowed for use.

**SEAMLESS STEEL BOILER TUBES.**

**MATERIAL.**

The steel shall be made by the open-hearth process.

**SURFACE INSPECTION.**

Tubes must be free from all surface defects. The defects to be particularly avoided in seamless tubes are tears, snakes, checks, slivers, scratches, laps, pits, rings, and sinks.

All seamless steel cold-drawn tubes shall be annealed as a final process. One or more tubes shall be selected at random from each charge of annealing furnace, and coupons cut from same for testing.

(a) A piece 3 inches long cut from the first tube must stand being flattened by hammering until the sides are brought parallel with a curve on the inside at the ends not greater than three times the thickness of the metal, without showing cracks or flaws.

(b) A flange shall be turned all around the end of the tube to a width equal to three-eighths of an inch beyond the outside body of the tube.

Tests (a) and (b) shall be done cold.

(II, 13) Where hot-finished tubes are furnished, the tubes shall pass the same manipulating tests as cold-drawn tubes and shall be subject to the same conditions as to gauge, but do not have to be annealed.

Each tube shall be subject to an internal hydrostatic pressure of 1,000 pounds per square inch without showing signs of weakness or defects.

All tubes must stand expanding, flanging over on the tube plate, and beading without flaw or crack.

All individual tubes must be carefully gauged with a Birmingham wire gauge, and must come within the limits of one gauge under or one gauge over the specified thickness.

#### STATEMENT OF MANUFACTURER OF BOILER TUBES.

The manufacturer of boiler tubes must furnish the purchaser of each lot of tubes a statement of the kind of material of which the tubes are made, and that the tubes have been tested and have met all the requirements of the rules, and the statement must be furnished to the boiler manufacturer using the tubes, who will forward same to the local inspectors of the district in which the boiler is to be inspected.

#### WELDED STEAM AND WATER PIPES.

From one-eighth of an inch inside diameter up to and including 30 inches inside diameter.

The pipe shall be made of wrought iron or mild steel, smooth, straight, and free from defects.

Threaded pipe of standard thickness shall be avoided as far as possible. In steam pipes it is a very serious matter and shall not be allowed in any case on standard pipe over 5 inches in diameter.

All pipe over 2 inches in diameter shall be lap-welded.

#### TESTS.

The following tests shall be made before shipment by the manufacturer:

One-eighth inch inside diameter up to and including 3½ inches inside diameter shall be tested before shipment to 600 pounds per square inch hydrostatic pressure and not subject to any other test.

Four inches inside diameter up to and including 12 inches inside diameter.

Thirteen inches outside diameter up to and including 30 inches outside diameter.

(a) A test piece 2 inches in length cut from a pipe must stand being flattened by hammering until the sides are brought parallel with the curve on the inside at the ends not greater than three times the thickness of the metal

without showing cracks or flaws, with bend at one side being in the weld. (II, 13)

(b) Pulling tests must be made from every 50 pieces furnished, or fraction thereof, and must show the following results:

*For steel.*—Tensile strength not less than 50,000 pounds per square inch. Elongation in 8-inch specimen, not less than 20 per cent.

*For iron.*—Tensile strength not less than 44,000 pounds per square inch. Elongation in 8-inch specimen, not less than 12 per cent.

All pipe from 4-inch diameter up to and including 30-inch diameter shall be tested before shipment to not less than 500 pounds per square inch hydrostatic pressure.

#### SEAMLESS STEEL STEAM AND WATER PIPES.

##### MATERIAL.

The steel shall be made by the open-hearth process.

##### SURFACE INSPECTION.

Pipe must be free, inside and outside, from all surface defects that would materially weaken it or form starting points of corrosion. The defects to be especially avoided are snakes, checks, slivers, laps, pits, etc. Pipe must be smooth and straight.

##### TESTS.

The following tests shall be made before shipment by the manufacturer:

(a) A test piece, 2 inches in length, cut from a tube, must stand being flattened by hammering until the sides are brought parallel with the curve on the inside at the ends not greater than three times the thickness of the metal without showing cracks or flaws.

(b) Pulling tests must be made from every 50 pieces furnished, or fraction thereof, and must show the following results:

Tensile strength, not less than 48,000 pounds per square inch.

Elongation in 8-inch specimen, not less than 12 per cent.

The results of the pulling tests must be forwarded by the manufacturer to the purchaser of steam pipe, who will forward same to the local inspectors.

Any pipe used for mud or steam drums must have the ends of same properly annealed before the holes are drilled or the heads are riveted in: *Provided*, That this paragraph shall apply only to drums not exceeding 15 inches in diameter for use on pipe and coil boilers.

(II, 13)

When pipe is used for steam lines where flanges are riveted on and calked, the ends of the pipe shall be properly annealed before drilling or riveting the flanges on.

Flanges made of wrought iron or steel, grooved on the inner side of hub to a depth equal to the thickness of material in pipe, will be allowed for use in all steam and feed pipes, provided the ends of pipes have been thoroughly annealed and expanded into such flanges by approved machinery.

When pipes are expanded into flanges by proper and approved machinery, and flared out at the ends to an angle not exceeding  $20^{\circ}$  (said angle to be taken in the direction of the length of the pipe) and having a depth of flare equal to *at least* one and one-half times the thickness of the material in said pipe, such pipes may be used for all steam and exhaust pipes when tested to two and one-half times the working pressure and found perfect in every respect.

If the pipe is used for steam lines where the pipe is peened in and flanged over, the ends of the pipe should be properly annealed before the peening or flanging is done.

The use of a square-nosed tool is recommended for cutting tubes and pipe.

*Provided*, That this entire section 13 shall apply only to tubes and pipes used or to be used in boilers built after June 30, 1905, and to all other pipes referred to in this section subject to pressure installed for use on steam vessels after that date.

#### ANGLE STIFFENERS FOR CURVED SURFACES.

§ 4418, R. S.

14. Where rounded bottoms of combustion chambers are stiffened with single angle-iron stiffeners, such angles shall have a thickness of leaf eight-tenths that of the plate and a depth of at least one-half pitch. Where stiffened with double angle irons or tee bars, such angles or tee bars shall have a thickness of leaf at least two-thirds that of plate and a depth of at least one-fourth of pitch. Said angles or tee bars shall be substantially riveted to the plate supported. Where the bottoms of combustion chambers are strengthened by angles or tee irons, the same shall be on the water side of the combustion chambers as shown in the sketches on pages 33-37.

Where rounded tops of combustion chambers are stiffened with single or double angle-iron stiffeners or tee bars, such angles or tee bars shall be of thickness and depth of leaf not less than specified for rounded bottoms of combustion chambers. Said angles or tee bars shall be supported on thimbles and riveted through with rivets not less than one inch in diameter, and spaced not to exceed six inches between centers.

Working pressure allowed on rounded surfaces supported by angle irons or tee bars shall be determined by the following formula: (II, 14)

$$\text{Working pressure} = \frac{900 \times T^2}{P \times D}$$

Where  $T$  = thickness of plate in sixteenths of an inch.  
 $P$  = pitch of angle or tee stiffeners, in inches.  
 $D$  = diameter of curve to which plate is bent, in inches.

#### EXAMPLE.

Given  $T = \frac{9}{16}$  of an inch.  $P = 7$  inches.  $D = 51$  inches.  
 Substituting values in formula and solving,

$$\text{Working pressure} = \frac{900 \times 81}{7 \times 51} = 204 \text{ pounds per square inch.}$$

PRESSURE PERMISSIBLE ON ROUNDED BOTTOM OF COMBUSTION CHAMBERS, ANGLES BEING OMITTED.

$$P = \frac{50 (300T - 2L)}{D}$$

Where  $P$  = working pressure in pounds.  
 $T$  = thickness of bottom plate of combustion chamber in inches.  
 $L$  = extreme length of plate forming bottom of combustion chamber in inches.  
 $D$  = twice outside radius of bottom of combustion chamber in inches.

Required working pressure on bottom plate of a combustion chamber, angles being omitted: Thickness of plate, .82 of an inch; extreme length of plate, 33 inches; twice the radius of bottom of combustion chamber, 50 inches. Substituting and solving:

$$P = \frac{50 \times (300 \times .82 - 2 \times 33)}{50} = 180 \text{ pounds.}$$

$$T = \frac{P \times D + 100L}{15,000}$$

#### TUBE PLATE.

$$P = \frac{(D - d) T \times 27,000}{W \times D}$$

Where  $P$  = working pressure in pounds.  
 $D$  = least horizontal distance between tube centers in inches.  
 $d$  = inside diameter of tubes in inches.  
 $T$  = thickness of tube plate in inches.  
 $W$  = extreme width of combustion chamber in inches.

- (II, 14) Required the working pressure of a tube sheet supporting a crown sheet braced by crown bars. Horizontal distance between centers,  $4\frac{1}{2}$  inches; inside diameter of tubes, 2.782 inches; thickness of tube sheets, eleven-sixteenths of an inch; extreme width of combustion chamber,  $34\frac{1}{2}$  inches, measured from outside of tube plate to outside of back plate; material, steel. Substituting and solving:

$$P = \frac{(4.125 - 2.782) \times .6875 \times 27,000}{34.25 \times 4.125} = 176 \text{ pounds pressure.}$$

The compressive stress on tube plates, as determined by the following formula, must not exceed 13,500 pounds per square inch, when pressure on top of combustion chamber is supported by vertical plates of such chamber.

$$C = \frac{P \times D \times W}{2 (D - d) T}$$

Where C = stress on tube sheet.

P = working pressure in pounds.

D = least horizontal distance between tube centers in inches.

d = inside diameter of tube in inches.

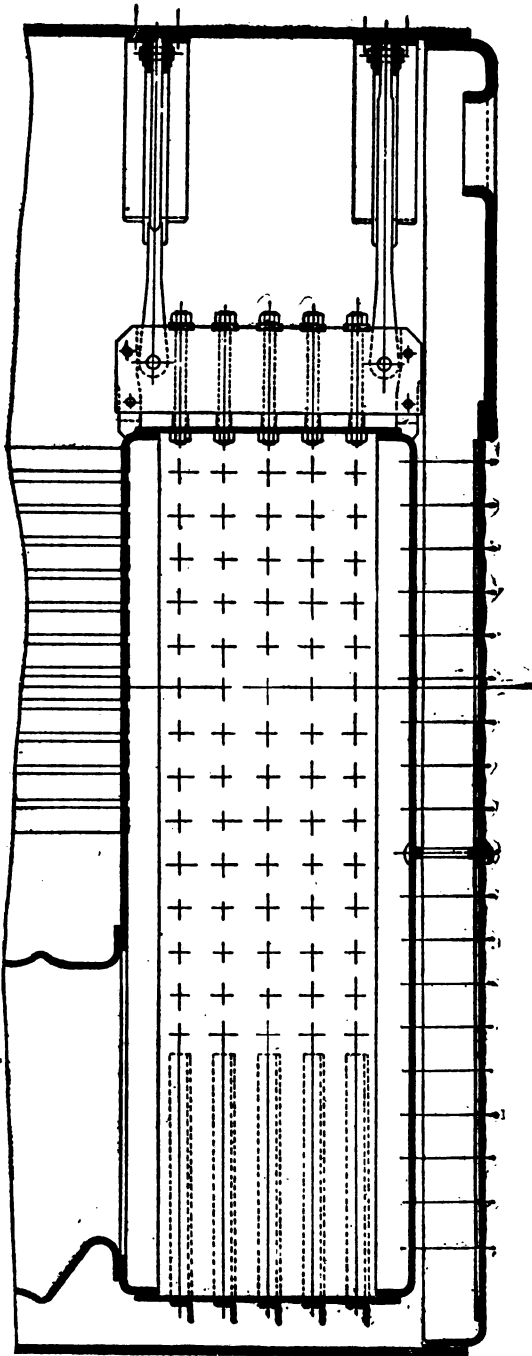
W = extreme width of combustion chamber in inches.

T = thickness of tube sheet in inches.

Sling stays may be used in lieu of girders in all cases, provided, however, that when such sling stays are used, girders or screw stays of the same sectional area must be used for securing the bottom of combustion chamber to the boiler shell.

When girders are dispensed with and the top and bottom of combustion chambers are secured by sling stays or braces, the sectional area of such stays must conform with the requirements of section 9, Rule II.

The following drawings show an excellent practice of constructing combustion chambers with and without sling stays:



NO. 1.—FULL LOAD ON TUBE SHEET AND BACK PLATE.

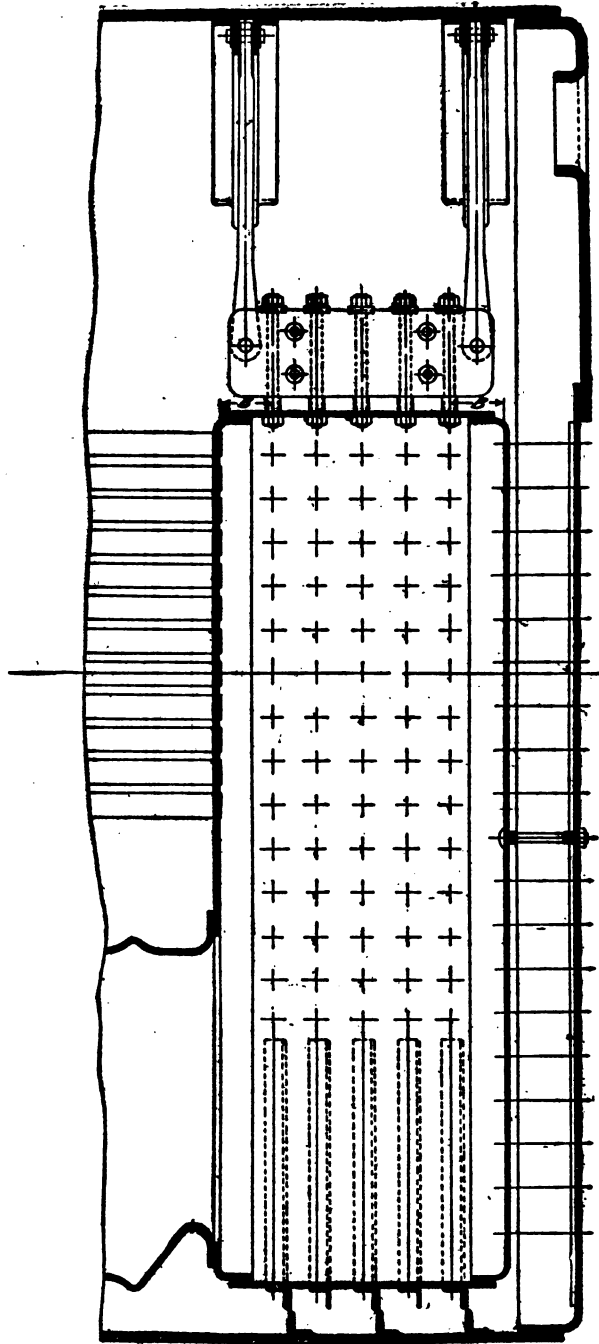
Diameter of hangers should be sufficient to carry the weight of combustion chamber and one-half the tubes and furnaces when no water is in boiler. No effect of buoyancy is considered.

These remarks are for separate combustion chambers when they are not secured to the shell at the bottom and therefore liable to bend the small screw stays.

In this case the tube sheet and back plate get the full compressive load in a similar manner to a boiler without hanging stays.



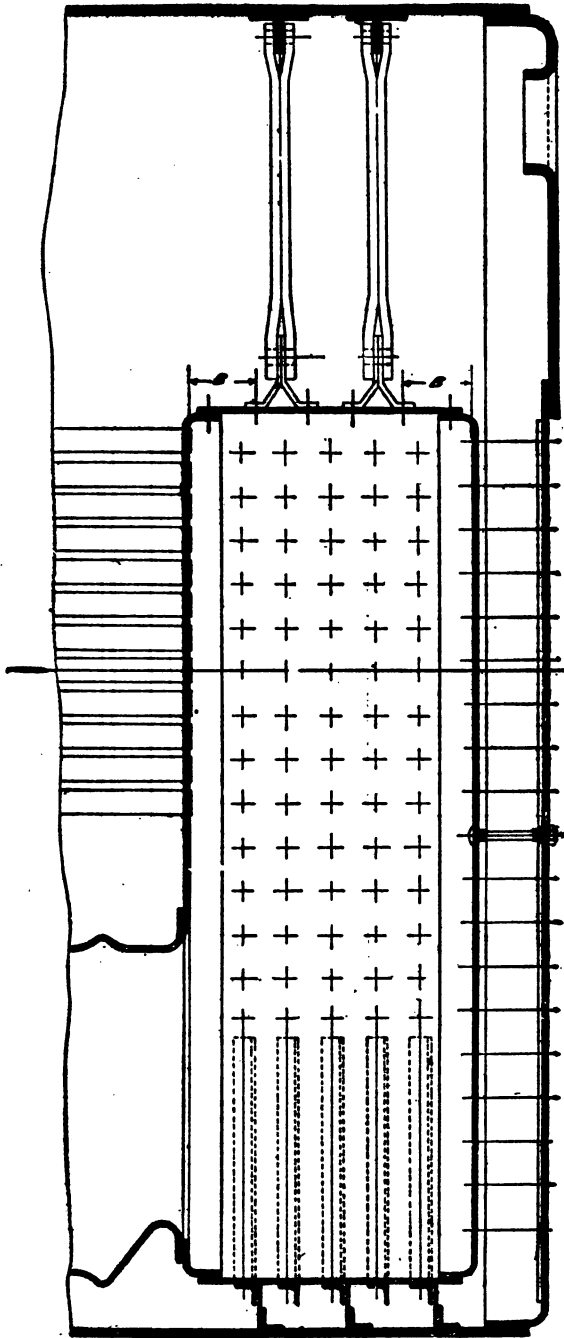
(II, 14)



NO. 2.—NEARLY WHOLE COMPRESSIVE LOAD TAKEN OFF TUBE SHEET.

Top hanging stays take full compressive load off tube sheet and back plate, except that half the load on unsupported portions marked B beyond stays will be taken by the tube sheet and back plate, respectively, and the other half by the last stays.

The thickness of tube sheet and back plate may be materially reduced from what would be required when tube sheet and back plate take full compressive load, providing that combustion chamber is well stayed to take full load at the bottom by screw stays or girders of plates and angles.

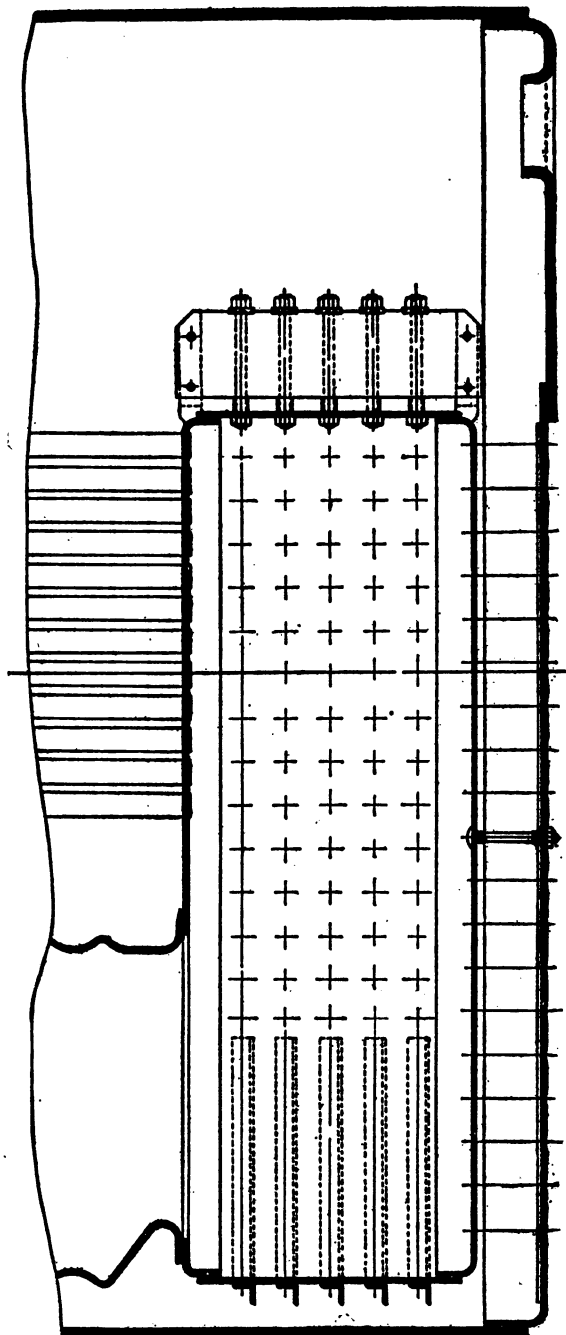


No. 3.—NEARLY WHOLE COMPRESSIVE LOAD TAKEN OFF TUBE SHEET.

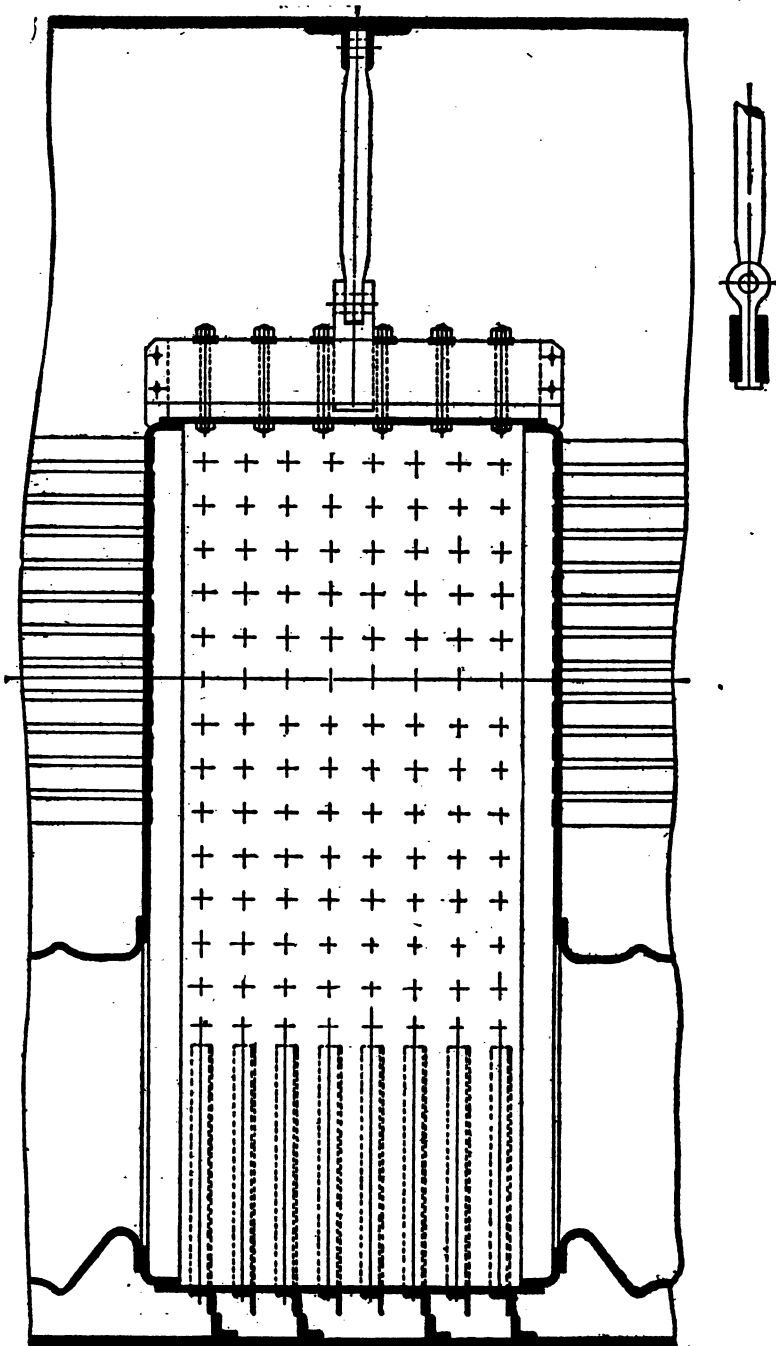
Top hanging stays take full compressive load off tube sheet and back plate, except that half the load on unsupported portions marked B beyond stays will be taken by the tube sheet and back plate, respectively, and the other half by the last stays.

The bottom stays, whether of screw stays or girders of plates and angles, must be of the same sectional area as the top braces, and no boiler should be built having top stays as shown without having the bottom stays of equal strength.

(II, 14)



No. 4.—TUBE SHEET AND BACK PLATE GET FULL LOAD,  
and therefore should be heavy enough to withstand such.



NO. 5.—TUBE SHEETS EACH TAKE PART OF COMPRESSIVE LOAD, THE HANGING STAYS TAKING CARE OF THE OTHER PART.

The bottom stays, whether of screw stays or girders of plates and angles, must be of the same sectional area as the top braces.

In this case the thickness of the tube sheets may be materially reduced from what would be required when tube sheets together take full compressive load.

## (II)

## FLUES.

§ 4418, R. S.

PLAIN, LAP-WELDED STEEL FLUES, 7 TO 18 INCHES DIAMETER.

15. Working pressures and corresponding minimum thicknesses of wall for long, plain, lap-welded and seamless steel flues, 7 to 18 inches diameter, subjected to external pressure only, shall be determined by the following table and formula:

Outside diameter of flue.	Working pressure in pounds per square inch.						
	100	120	140	160	180	200	220
	Thickness of flue in inches. Safety factor, 5.						
Inches.							
7	.152	.160	.168	.177	.185	.193	.201
8	.174	.183	.193	.202	.211	.220	.229
9	.196	.206	.217	.227	.237	.246	.255
10	.218	.229	.241	.252	.264	.275	.287
11	.239	.252	.265	.277	.290	.303	.316
12	.261	.275	.289	.303	.317	.330	.344
13	.283	.298	.313	.328	.343	.358	.373
14	.301	.320	.337	.353	.369	.385	.402
15	.328	.343	.361	.378	.396	.413	.430
16	.344	.363	.385	.404	.422	.440	.459
17	.366	.389	.409	.429	.448	.468	.488
18	.387	.412	.433	.454	.475	.496	.516

Thicknesses in this table were calculated by formula:

$$T = \frac{[(F \times P) + 1,386]D}{86,670}$$

Where D = outside diameter of flue in inches.

T = thickness of wall in inches.

P = working pressure in pounds per square inch.

F = factor of safety.

This formula is applicable to lengths greater than six diameters of flue, to working pressures greater than 100 pounds, to outside diameters of from 7 to 18 inches, and to temperatures less than 650° F.

## EXAMPLE.

Required the thickness of a flue 10 inches in diameter; working pressure, in pounds per square inch, 200; factor of safety, 5. Substituting and solving:

$$T = \frac{[(5 \times 200) + 1,386] 10}{86,670} = .275 \text{ of an inch.}$$

To determine working pressure, diameter and thickness being given.

$$P = \frac{(T \times 86,670) - (1,386 \times D)}{D \times F}$$

Where D = outside diameter of flue in inches.

T = thickness of wall in inches.

P = working pressure in pounds per square inch.

F = factor of safety.

## EXAMPLE.

(II, 15)

Required the working pressure of a flue 12 inches outside diameter, .375 of an inch thick; factor of safety is 5. Substituting and solving:

$$P = \frac{(.375 \times 86,670) - (1,386 \times 12)}{12 \times 5} = 264.4 \text{ pounds pressure.}$$

WORKING PRESSURE ALLOWABLE ON RIVETED FLUES OVER 6 AND NOT OVER 18 INCHES IN DIAMETER, MADE IN SECTIONS, AND SUBJECTED TO EXTERNAL PRESSURE ONLY.

When flues are constructed of plates made in sections and efficiently riveted together, not less than 24 inches in length, minimum thickness, .25 of an inch, over 6 and not exceeding 18 inches in diameter, the working pressure shall be determined by the following formula:

$$P = \frac{8,100 \times T}{D}$$

Where P = working pressure in pounds per square inch.

T = thickness in inches.

D = outside diameter in inches.

## EXAMPLE.

Required the working pressure of a flue 13 inches outside diameter, .33 of an inch thick.

Substituting values and solving:

$$P = \frac{8,100 \times .33}{13} = 205 \text{ pounds.}$$

WORKING PRESSURE ALLOWABLE ON RIVETED, SEAMLESS, OR LAP-WELDED FLUES OVER 18 AND NOT OVER 28 INCHES IN DIAMETER, MADE IN SECTIONS, AND SUBJECTED TO EXTERNAL PRESSURE ONLY.

The working pressure allowable on riveted, seamless, or lap-welded flues over 18 inches in diameter up to and including 28 inches in diameter, made in sections not less than 24 inches in length, efficiently riveted together, sections not to exceed  $3\frac{1}{2}$  times the diameter of the flue, when subjected to external pressure only, shall be determined by the following formula:

$$P = \frac{51.5}{D} \left[ (18.75 \times T) - (L \times 1.03) \right]$$

Where P = working pressure in pounds per square inch.

D = outside diameter of flue in inches.

L = length of flue in inches, not to exceed  $3\frac{1}{2}$  diameters of flue.

T = thickness of wall in sixteenths of an inch.

(II, 15)

## EXAMPLE.

Required the working pressure of a flue 19 inches outside diameter, .4375 of an inch thick, length 66 inches.

Substituting values and solving:

$$P = \frac{51.5}{19} \left[ (18.75 \times 7) - (66 \times 1.03) \right] = 171 \text{ pounds pressure.}$$

Inspectors are required, from actual measurement of each flue, to make such reduction from the prescribed working steam pressure for any deviation in the uniformity of the thickness of material, or for any deviation in the form of the flue from that of a practically true circle, also to examine riveted seams in order to satisfy themselves as to the efficiency and workmanship.

## FURNACES.

§ 4418, R. S.

16. The tensile strength of steel used in the construction of corrugated or ribbed furnaces shall not exceed 67,000 and be not less than 54,000 pounds; and in all other furnaces the minimum tensile strength shall not be less than 58,000 and the maximum not more than 67,000 pounds. The minimum elongation in 8 inches shall be 20 per cent.

All corrugated furnaces having plain parts at the ends not exceeding 9 inches in length (except flues especially provided for), when new, and made to practically true circles, shall be allowed a steam pressure in accordance with the following formula:

$$P = \frac{C \times T}{D}$$

## LEEDS SUSPENSION BULB FURNACE.

$$P = \frac{C \times T}{D}$$

Where P = pressure in pounds.

T = thickness in inches, not less than five-sixteenths of an inch.

D = mean diameter in inches.

C = a constant, 17,300, determined from an actual destructive test under the supervision of the Board, when corrugations are not more than 8 inches from center to center, and not less than 2½ inches deep.

## MORISON CORRUGATED TYPE.

$$P = \frac{C \times T}{D}$$

Where P = pressure in pounds.

T = thickness in inches, not less than five-sixteenths of an inch.

D = mean diameter in inches.

C = 15,600, a constant, determined from an actual destructive test under the supervision of the Board of Supervising Inspectors, when corrugations are not more than 8 inches from center to center and the radius of the outer corrugations is not more than one-half of the suspension curve.

[In calculating the mean diameter of the Morison furnace, the least inside diameter plus 2 inches may be taken as the mean diameter, thus—

Mean diameter = least inside diameter + 2 inches.]

FOX TYPE.

$$P = \frac{C \times T}{D}$$

Where P = pressure in pounds.

T = thickness in inches, not less than five-sixteenths.

D = mean diameter in inches.

C = 14,000, a constant, when corrugations are not more than 8 inches from center to center and not less than  $1\frac{1}{2}$  inches deep.

PURVES TYPE.

$$P = \frac{C \times T}{D}$$

Where P = pressure in pounds.

T = thickness in inches, not less than seven-sixteenths.

D = least outside diameter in inches.

C = 14,000, a constant, when rib projections are not more than 9 inches from center to center and not less than  $1\frac{3}{8}$  inches deep.

BROWN TYPE.

$$P = \frac{C \times T}{D}$$

Where P = pressure in pounds.

T = thickness in inches, not less than five-sixteenths.

D = least outside diameter in inches.

C = 14,000, a constant (ascertained by an actual destructive test under the supervision of this Board), when corrugations are not more than 9 inches from center to center and not less than  $1\frac{3}{8}$  inches deep.

(II, 16)



- (II, 16) The thickness of corrugated and ribbed furnaces shall be ascertained by actual measurement. The manufacturer shall have said furnace drilled for a one-fourth inch pipe tap and fitted with a screw plug that can be removed by the inspector when taking this measurement. For the Brown and Purves furnaces the holes shall be in the center of the second flat; for the Morison, Fox, and other similar types in the center of the top corrugation, at least as far in as the fourth corrugation from the end of the furnace.

TYPE HAVING SECTIONS 18 INCHES LONG.

$$P = \frac{C \times T}{D}$$

Where P=pressure in pounds.

T=thickness in inches, not less than seven-sixteenths.

D=mean diameter in inches.

C=10,000, a constant, when corrugated by sections not more than 18 inches from center to center and not less than  $2\frac{1}{2}$  inches deep, measuring from the least inside to the greatest outside diameter of the corrugations, and having the ends fitted one into the other and substantially riveted together, provided that the plain parts at the ends do not exceed 12 inches in length.

#### ADAMSON TYPE.

When plain horizontal flues are made in sections not less than 18 inches in length, and not less than five-sixteenths of an inch thick, and flanged to a depth of not less than three times the diameter of rivet hole plus the radius at furnace wall (inside diameter of furnace), the thickness of the flanges to be as near the thickness of the body of the plate as practicable.

The radii of the flanges on the fire side shall be not less than three times the thickness of plate.

The distance from the edge of the rivet hole to the edge of the flange shall be not less than the diameter of the rivet hole, and the diameter of the rivets before driven shall be at least one-fourth inch larger than the thickness of the plate.

The depth of the ring between the flanges shall be not less than three times the diameter of the rivet holes, and the ring shall be substantially riveted to the flanges. The fire edge of the ring shall terminate at or about the point of tangency to the curve of the flange, and the thickness of the ring shall be not less than one-half inch.

The pressure allowed shall be determined by the following formula:

ADAMSON FURNACES IN SECTIONS OF NOT LESS THAN 18 INCHES IN LENGTH. (II, 16)

$$P = \frac{57.6}{D} \left[ (18.75 \times T) - (1.03 \times L) \right]$$

Where P = working pressure in pounds per square inch.  
 D = outside diameter of furnace in inches.  
 L = length of furnace in inches.  
 T = thickness of plate in sixteenths of an inch.

EXAMPLE.

Given a furnace 44 inches in diameter, 48 inches in length, and one-half of an inch thick. Substituting values in formula, we have

$$P = \frac{57.6}{44} \left[ (18.75 \times 8) - (1.03 \times 48) \right]$$

$$1.309 (150 - 49.44) = 131 \text{ pounds.}$$

PLAIN CIRCULAR RIVETED FLUES, FURNACES AND CONE TOPS MADE IN SECTIONS OF NOT LESS THAN 18 INCHES IN LENGTH AND NOT LESS THAN FIVE-SIXTEENTHS OF AN INCH THICK.

Cylindrical riveted flues and furnaces made in sections of not less than 18 inches in length fitted one into the other and substantially riveted, combustion chambers for vertical submerged tubular boilers in the shape of a frustum of a cone, constructed to a practically true circle, shall be allowed a steam pressure according to the following formula:

$$P = \frac{51.5}{D} \left[ (18.75 \times T) - (1.03 \times L) \right]$$

Where P = working pressure in pounds per square inch.  
 D = outside diameter of furnaces in inches, or outside *mean* diameter of cone top in inches.  
 L = length of furnace or flue in inches.  
 T = thickness of furnace or cone top in sixteenths of an inch, not to be less than five-sixteenths of an inch.

When diameter of plain furnaces and flues used in vertical type of boilers or mean diameter of cone tops exceeds 42 inches, they shall be deemed a flat surface and must be stayed in accordance with rules governing flat surfaces. If a greater working pressure than given by formula is desired for mean diameters under 42 inches, the flues or cone tops shall be substantially stayed for such additional pressure.

(II, 16)

## EXAMPLE.

Given a furnace 26 inches in diameter, 28 inches in height, and five-sixteenths of an inch thick. A steam pressure of 175 pounds is desired.

Substituting values in formula,

$$P = \frac{51.5}{26} \left[ (18.75 \times 5) - (1.03 \times 28) \right] = 128 \text{ pounds.}$$

175 - 128.5, an excess of 46.5 pounds, therefore furnace must be braced.

Substituting 46.5 for working pressure, W. P. in formula.

$$\text{Working pressure, W. P.} = \frac{C \times T^2}{P^2}.$$

Solving for  $P^2$ ,

$$P^2 = \frac{112 \times 5^2}{46.5},$$

$$P = \sqrt{60.21} = 7.7.$$

Pitch of  $7.7 \times 7.7 = 59.29$  area.

To determine size of stay bolt. Area multiplied by pressure per square inch equals total stress on stay. Thus,  $59.29 \times 46.5 = 2,756.985$  pounds pressure on the plate. Thus, 2,756.985 divided by 6,000 = .4594 area of stay bolt, practically a thirteen-sixteenths of an inch stay bolt taken at root of thread.

## SUPERHEATERS OR STEAM CHIMNEYS.

§ 4418, R. S.

17. When superheaters or steam chimneys constructed of flues subject to external pressure have a thickness of not less than seven-sixteenths of an inch, and the flue is heated only with the waste gases, and the temperature does not exceed 600° F., the working pressure may be determined by the rules for plain furnaces or flues, corrugated furnaces and Adamson type. When flues are strengthened with tee irons or bowling rings the working pressure shall be determined by formula for, plain furnace flues. Pitch of stays and the maximum stress in pounds allowable per square inch of cross-sectional area for stays shall be determined by section 9, Rule II. Plain flues shall be strengthened with double angle or tee bars. Such angle or tee bars shall have a thickness of leaf of at least two-thirds that of plate, and a depth of at least one-fourth of pitch. Said tee bars shall be substantially riveted to flue. All rivet holes in tees shall be drilled, holes shall be staggered, distance from center of rivet holes to edge of tees shall be not less than 1.5 times diameter of rivet holes, and percentage of plate

section shall be not less than rivet section. Bowling rings may be used with a moderate thickness of plate, as they increase the strength and provide for expansion of flue. For all boilers carrying a steam pressure of over 60 pounds and not over 100 pounds per square inch, the flue may be braced with socket bolts in lieu of tee rings. Such bolts shall have heads and the ends shall be threaded for nuts, with plate washers or equivalent on the inside of flue. Pitch of bolts and the maximum stress in pounds allowable per square inch of cross-sectional area for bolts shall be determined by section 9, Rule II. (II, 17)

If a greater working stress is desired on flues than that permitted by the formula for flues strengthened with bowling rings or tee irons, the flue may be braced to shell and may be deemed a flat surface, and must be stayed in strict accordance with the rules for stays.

Drainpipes shall be fitted to superheaters in which water is liable to collect. Superheaters that are arranged to be disconnected from main boiler shall be provided with a safety valve not less than 3 inches in diameter and with a steam gauge, and shall be provided with manholes, to enable inspectors to examine every portion of the interior. Hand-hole and manhole plates shall be made of homogeneous cast steel or of drop-forged or hydraulic-pressed flange steel. Cast iron shall not be allowed in construction of any fittings used in connection with superheated steam. The steam outlet shall be located at the highest point of superheater.

#### SOCKET BOLTS.

18. For all boilers carrying a steam pressure of 60 pounds and under per square inch the flue may be braced with socket bolts in lieu of angle rings, such bolts to have heads and the ends to be threaded for nuts, with plate washers not over 12 inches between centers (or equivalent) on the inside of the flue; bolts to be at least 1 inch in diameter at bottom of thread. § 4418, R. S.

For all boilers carrying a steam pressure of over 60 pounds and not over 120 pounds per square inch the flue may be braced with socket bolts in lieu of angle rings, such bolts to have heads and the ends to be threaded for nuts, with plate washers not over 10 inches between centers (or equivalent) on the inside of flue; bolts to be at least  $1\frac{1}{8}$  inches in diameter at bottom of thread.

#### PIPES.

##### COPPER.

19. All copper pipe subject to pressure shall be flanged over or outward to a depth of not less than twice the thickness of the material in the pipe, and such flanging shall be made to a radius not to exceed the thickness of the pipe. On boilers whose construction was commenced after June § 4418, R. S.

- (II, 19) 30, 1905, no bend will be allowed in copper pipe of which the radius is less than one and one-half times the diameter of the pipe, and such pipe must be so led and flanges so placed that they may be readily taken down if required. Such pipes must be protected by iron casings when run through coal bunkers, and must be clear of the coal chutes. The thickness of material, according to the working pressure, shall be determined by the following formula:

$$T = \frac{P \times D}{8,000} + .0625.$$

Where T = thickness in inches.

P = working pressure.

D = inside diameter of pipe in inches.

**EXAMPLE.**

Required the thickness of material of a 5-inch copper pipe for a working pressure of 175 pounds per square inch. Substituting values, we have

$$T = \frac{175 \times 5}{8,000} + .0625 = .171 \text{ inch.}$$

*Provided, however,* That all copper pipe subject to pressure and installed for use on steam vessels after July 1, 1911, shall have a thickness of material according to the working pressure, to be determined by the following formula. This proviso shall not apply to copper pipe contracted for previous to June 1, 1911.

$$T = \frac{P \times D}{6,000} + .0625.$$

Where T = thickness in inches.

P = working pressure.

D = inside diameter of pipe in inches.

**EXAMPLE.**

Required the thickness of material of a 5-inch copper pipe for a working pressure of 175 pounds per square inch. Substituting and solving, we have

$$T = \frac{175 \times 5}{6,000} + .0625 = .208.$$

The flanges of all copper steam pipes over 3 inches in diameter shall be made of brass or bronze composition, forged iron or steel, or open-hearth steel castings, and shall be securely brazed or riveted to the pipe: *Provided, however,* That when such pipes are properly formed with a taper through the flange, such taper being fully reenforced, the riveting or brazing may be dispensed with: *And provided also,* That when the pipe has been expanded

by proper and capable machinery into grooved flanges and the pipe flared out at the ends to an angle of approximately  $20^\circ$ , said angle to be taken in the direction of the length of the pipe, and having a depth of flare equal to at least one and one-half times the thickness of the material in the pipe, said riveting or brazing may be dispensed with. Where copper pipes are expanded into or riveted to flanges, it will be necessary for the pipes with their flanges attached to withstand a hydrostatic pressure of two and one-half times the boiler pressure. (II, 19)

Flanges shall be not less than four times the required thickness of pipe, plus one-fourth of an inch, and shall be fitted with such number of good and substantial bolts as shall make the joints at least equal in strength to all other parts of the pipe.

Any form of joint that will add to the safety or increase the strength of flange and pipe connections over those provided for by this rule will be allowed on any and all classes of steam pipe.

#### STEEL FEED AND STEAM PIPE.

The terminal and intermediate flanges of all wrought-iron and homogeneous-steel feed and steam pipes over 2 inches in diameter, other than on pipe or coil boilers or steam generators, shall be made of wrought iron, homogeneous steel, or equivalent material; and all such flanges shall have a depth through the bore of not less than that equal to one-half of the diameter of the pipe to which any such flange may be attached; and such bores shall increase slightly toward the face of the flanges, and the ends of such pipes shall be enlarged to fit the bore of the flanges, and they shall be substantially beaded over or outward into a recess in the face of each flange. Flanges welded to wrought-iron, Bessemer, or other steel pipes may be used: *Provided*, That on boilers constructed prior to June 30, 1905, the foregoing provisions of this paragraph shall apply only to such pipes when over 3 inches in diameter.

But where such pipes are made of extra heavy lap-welded steam pipe up to and including 5 inches in diameter the flanges may be attached with screw threads, and all joints in bends may be made with good and substantial malleable-iron elbows or equivalent material.

All feed and steam pipes of 2 inches in diameter or under may be connected at their intermediate joints by being screwed into flanges, sleeves, elbows, union couplings, or other fittings.

Where the thickness of the material in the boiler or drum, or the heads thereof, is not less than one-half inch, or where such boiler, drum, or head thereof has been reenforced by having a pad or flange riveted on the same, to make the thickness not less than one-half inch, pipes of 2 inches in diameter or under may be screwed directly into the same. Where steam or feed pipes of 2 inches in

(II, 19) diameter or under are screwed into the boiler, the stop valve shall be connected to the boiler by as short a nipple as it is possible to use.

All lap-welded or riveted wrought-iron or steel or seamless drawn steel steam pipes over  $5\frac{1}{2}$  inches in diameter when expanded into tapered holes, or where pipe is brought to a true and parallel circle at the ends and the flanges shrunk on the same and beaded over into a recess at the face of the flanges, or when flared to an angle of approximately 20 degrees, shall be substantially riveted through the hubs of said flanges, and no hubs shall project less than  $1\frac{1}{4}$  inches from the back of said flanges: *Provided, however,* That when such pipes are double riveted into cast-steel, wrought-iron, or homogeneous-steel flanges, said flanges to be equal in strength to the strength of the pipe, the process of expanding and beading may be dispensed with: *It is further provided,* That for pressures of 100 pounds and under, said pipes may be single riveted to the flanges in lieu of double riveting.

The joints of all flanges shall be made with a sufficient number of good and substantial bolts or rivets to make such joints at least equal in strength to all other parts of the pipe.

Lap-welded steam pipes of iron or steel, with their flanges welded on, shall be tested by a hydrostatic pressure of at least double the working pressure of the steam to be carried, and properly annealed after all the work requiring fire is finished. When an affidavit of the manufacturer is furnished that such test has been made and pipes so annealed, they may be used for marine purposes.

When holes exceeding 6 inches in diameter are cut in boilers for pipe connections, manhole and hand-hole plates, such holes shall be reenforced, either on the inside or outside of boiler, with reenforcing wrought-iron or steel rings, which shall be securely riveted or properly fastened to the boiler, such reenforcing material to be rings of sufficient width and thickness of material to fully compensate for the amount of material cut from such boilers, in flat surfaces; and where such opening is made in the circumferential plates of such boilers, the reenforcing ring shall have a sectional area equal to at least one-half the sectional area of the opening parallel with the longitudinal seams of such portion of the boiler. On boilers carrying 75 pounds or less steam pressure a cast-iron stop valve, properly flanged, may be used as a reenforcement to such opening. When holes are cut in any flat surface of such boilers and such holes are flanged inwardly to a depth of not less than  $1\frac{1}{4}$  inches, measuring from the outer surface, the reenforcement rings may be dispensed with.

No connection between shell of boiler and mud drum shall exceed 9 inches in diameter, and the flange of the mud-drum leg shall consist of an equal amount of material to that cut out of the shell of boiler.

Plates constructed of pressed steel of corrugated form without opening in plate for bolt, the corrugation forming the support for bolt, shall be allowed for manhole and hand-hole plates. (II, 19)

#### SLIP JOINTS.

The wearing surface of the male pipe in all slip joints made after June 30, 1908, for use in steam pipes shall be of copper or composition, and the said male pipe shall be of sufficient length and so adjusted as to prevent accidental withdrawal from the stuffing box.

CAST STEEL, SEMISTEEL, FERROSTEEL, CAST IRON, MALLEABLE IRON, HARD BRASS, BRONZE, AND OTHER COMPOSITIONS MADE OF COPPER, TIN, AND ZINC.

20. Cast-steel fittings of any size or character, and for any pressure, may be used for any and all steam and feed-pipe connections, and for boiler fittings, valves, cocks, and all appliances subject to steam or water pressure in connection with the boilers and engines of steam vessels, when made by regular processes and by manufacturers who stamp such fittings and appliances with their trademark or identifying stamp and who guarantee the castings to possess the following physical characteristics: Tensile strength, minimum, 50,000; maximum, 65,000 pounds per square inch; elastic limit, minimum, not less than 45 per cent of tensile strength; elongation in 2 inches, minimum, 25 per cent. There shall be taken from each heat an annealed coupon or coupons, for the purpose of determining the physical tests, and the manufacturers shall furnish coupons to the local inspectors for tests when so required. All steel castings shall be thoroughly annealed. *Provided*, That castings made by the crucible process shall not be limited to a maximum tensile strength of 65,000 pounds per square inch. § 4418, R. S.

The minimum thickness of steel fittings shall be determined by the following formula:

$$T = \frac{P \times D}{5,000} + .188$$

Where P = working pressure in pounds.

D = diameter in inches.

T = thickness in inches.

Malleable iron possessing a tensile strength of not less than 30,000 pounds to the square inch may be used for any casting or connection up to and including 6 inches in diameter, and for pressures not exceeding 300 pounds. Such castings of 3 inches in diameter or over shall be extra



(II, 20) heavy, beaded, or banded, and stamped with the trade-mark or identifying stamp of the manufacturer.

Cast iron, semisteel, or ferrosteel, possessing a tensile strength of not less than 20,000 pounds to the square inch may be used in the construction of stop valves of any size when bolted directly to the boiler, throttle valves of any size when bolted directly to the steam chest, slip joints of any size, flanges, saddles, water columns, ells, tees, crosses, valves, and cocks, when such fittings of 3 inches in diameter or over are stamped with the trade-mark or identifying stamp of the manufacturer, and made in accordance with the following formula:

$$T = \frac{D \times P}{2,600} + \frac{1}{4}$$

Where P = pressure of steam allowable in pounds.

T = thickness of casting in inches.

D = inside diameter of casting in inches.

Cast iron may also be used in the construction of man-hole, and hand-hole plates.

When from peculiar form of construction, such as the engines of stern-wheel steamers, the throttle valve can not be connected directly to the steam chest, it shall be bolted directly to the end of the main steam pipe, and the branch pipes shall be bolted to the side pipes of the engines.

Hard brass, bronze, and other compositions, of which 95 per cent is copper, tin, and zinc, possessing a tensile strength of not less than 30,000 pounds to the square inch, may be used in the construction of all fittings up to and including 12 inches in diameter, and for all pressures not exceeding 300 pounds per square inch, and not exceeding a temperature of 425° F. For all pressures of more than 300 pounds, and a temperature of more than 425° F., no fittings other than steel shall be allowed.

All fittings of more than 3 inches in diameter shall be subjected by the manufacturer to a hydrostatic test of three and one-half times the pressure to which they will be subjected in service, and such hydrostatic pressure shall be plainly stamped on the casting.

All fittings of more than 2 inches in diameter shall be permanently flanged, and no fitting shall be of a greater length than specified by the "Manufacturer's Standard."

All cast-iron, malleable iron, semisteel, and ferrosteel castings shall be properly secured to the boiler by bolts or rivets.

Cast nozzles shall not be used when exposed to the direct action of the fire.

Screwed bonnets on cast-iron valves are positively prohibited. All valves over 2½ inches in diameter shall have

bolted bonnets or covers. The necks of the valves shall be extra heavy and as short as practicable. Where valves of less than  $2\frac{1}{2}$  inches in diameter are connected directly to the boiler, they shall be of cast steel, hard brass, or bronze. (II, 20)

#### VALVES.

All valves of 3 inches or more shall bear the trade-mark of the manufacturer, which shall guarantee the uniform thickness of the walls of the valve chamber.

All such valves shall also bear the number of pounds pressure of steam the manufacturer guarantees them to stand without rupture or distortion.

The manufacturers of all such valves and fittings shall file with the Supervising Inspector General a certificate duly sworn to that all material used in the manufacture of all valves and fittings furnished by them for use on boilers of steam vessels is, in all respects, fully up to the requirements of the foregoing rule.

After July 1, 1911, local inspectors shall refuse to allow the use of any such valves or fittings on boilers of steam vessels until notified by the Supervising Inspector General that such certificate is on file in his office. This shall not apply to valves and fittings installed previous to July 1, 1911.

#### EVAPORATORS, FEED-WATER HEATERS, AND SEPARATORS MADE OF CAST IRON AND SUBJECT TO BOILER PRESSURE.

When evaporators, feed heaters, and separators are constructed of cast iron possessing a tensile strength of not less than 20,000 pounds per square inch, the shells being cylindrical and ends flat or convex, the castings sound and of uniform thickness, the working pressure shall not exceed that found by the following formulas:

Flat surface:

$$P = \frac{20,000 \times T^2}{D^3}$$

Cylindrical shell:

$$P = \frac{3,500 \times T}{D}$$

$$T = \sqrt{\frac{P \times D^2}{20,000}}$$

$$T = \frac{P \times D}{3,500}$$

Where  $P$  = working pressure per square inch in pounds.

$T$  = thickness in inches.

*Provided*, 1. That the thickness of ends of evaporators, feed heaters, and separators shall be not less than three-eighths of an inch. 2. That to the resultant thickness obtained by the formula given above there shall be added, for cylinders having an inside diameter of 1 inch to 6 inches inclusive, one-quarter of an inch; for cylin-

- (II, 20) ders having an inside diameter of over 6 inches to 15 inches inclusive, one-eighth of an inch.

$D$  = diameter inside in inches. When the pressure is to be determined for a part of a flat surface which is a square, or rectangle in the flat surface formula, the value of  $D$  used shall be the diagonal of the square or rectangle, and when the ends are bolted to the shell the value of  $D$  used shall equal the diameter of the bolt circle.

All flanges shall be substantial, and there shall be a good fillet all around the root, and when the ends and shell are cast solid there shall be a good and substantial fillet inside all around.

The bolts or studs for the ends or doors shall not have a greater stress than 6,000 pounds per square inch, and the size of bolts or studs shall not be less than three-fourths of an inch in diameter.

Evaporators shall be provided with an efficient safety valve of approved type, same to be set to blow at 10 pounds pressure, and it shall be the duty of the engineer in charge of the vessel to see that such valve blows off at least once in 30 days.

§ 4418, R. S.

21. Feed water shall not be admitted into any marine boiler at a temperature less than 100° F., and every such boiler, excepting donkey boilers, shall, after October 31, 1909, have an independent auxiliary feed appliance for supplying said boiler with water in addition to the usual mode employed, which auxiliary feed shall enter the boiler through an opening and a fitting which are entirely independent of the fitting and opening for the main feed.

#### NAME PLATES.

§ 4418, R. S.

22. There shall be fastened to each boiler a plate containing the name of the manufacturer of the material, the place where manufactured, the tensile strength, the name of the builder of the boiler, when and where built.

The date of the building of the boiler or boilers shall be determined by the month and year of issue of the first certificate of inspection which covers the boiler or boilers in question: *Provided*, That the boiler or boilers have not been used for any purpose previous to the inspection.

#### FUSIBLE PLUGS.

§ 4418, R. S.

23. Every boiler, other than boilers of the water-tube type, shall have at least one fusible plug as described below. Plugs shall be made of a bronze casing filled with good Banca tin from end to end. The manufacturers of fusible plugs shall stamp their name or initials thereon for identification, and shall file with the local inspectors a

certificate, duly sworn to, that such plugs are filled with banca tin. (II, 23) 1

Fusible plugs, except as otherwise provided for, shall have an external diameter of not less than three-fourths of an inch pipe tap, and the banca tin shall be at least one-half of an inch in diameter at the smaller end and shall have a larger diameter at the opposite end of the plug: *Provided, however,* That all plugs used in boilers carrying a steam pressure exceeding 150 pounds to the square inch may be reduced at the smaller end of the banca tin to five-sixteenths of an inch in diameter.

Fusible plugs, when used in the tubes of upright boilers, shall have an external diameter of not less than three-eighths of an inch pipe tap, and the banca tin shall be at least one-fourth of an inch in diameter at the smaller end and shall have a greater diameter at the opposite end of the plug.

Externally heated cylindrical boilers, with flues, shall have one plug inserted in one flue, and also one plug inserted in shell of each boiler, immediately below the fire line and not less than 4 feet from the front end: *Provided, however,* That when such flues are not more than 6 inches in diameter a fusible plug of not less diameter than three-eighths-inch pipe tap may be used in such flues.

Other shell boilers, except especially provided for, shall have one plug inserted in the crown sheet of the back connection.

Vertical tubular boilers shall have one plug inserted in one of the tubes at least 2 inches below the lowest gauge cock, but in boilers having a cone top the plug shall be inserted in the upper tube sheet.

All plugs shall be inserted so that the small end of the banca tin shall be exposed to the fire.

It shall be the duty of the inspector at each annual inspection to see that the plugs are in good condition.

#### GAUGE COCKS AND WATER GLASS.

24. All boilers, except flash boilers, shall be supplied with at least one reliable water gauge and at least three gauge cocks attached directly to each boiler. When the gauge glass and gauge cocks are connected to the boilers by a water column there must be three additional gauge cocks inserted in the head or shell of boiler. The lower gauge cock in boilers more than 48 inches in diameter shall not be less than 4 inches from the top of the flues, tubes, or combustion chambers. In boilers less than 48 inches in diameter the lower gauge cock shall not be less than 2½ inches above the top of the flues, tubes, or combustion chambers. A gauge glass shall be considered a reliable water gauge, and a float such as used on western river steamers shall be considered on such boilers as a reliable water gauge: *Provided,* That when water-tube § 4418, R. S.

- (II, 24) boilers have an efficient water column connected to the steam drum of said boiler at the top, and the water manifold at the bottom, and such water column has a gauge glass and three gauge cocks fitted to same, and also is fitted with a valve or stop cock, both at top and bottom where the column is connected to the boiler, no gauge cocks shall be required in the head or shell of the drums of such water-tube boilers. \

Double-end boilers shall have at least three gauge cocks and one water glass at each end.

In vertical boilers or boilers of the water-tube type the location of the lowest gauge cock shall be determined by the local inspectors.

Boilers known as flash boilers constructed of a continuous coil of pipe or series of coils of pipes under three-fourths inch in diameter, whose construction has been approved by the Board of Supervising Inspectors, shall not be required to be supplied with gauge cocks or low-water gauges.

#### STEAM GAUGES.

§ 4418, R. S.

25. All boilers or sets of boilers shall have attached to them at least one gauge that will correctly indicate a pressure of steam equal to 80 per cent of the hydrostatic pressure applied by the inspectors.

#### SAFETY VALVES.

§ 4418, R. S.

26. The areas of all safety valves on boilers contracted for or the construction of which commenced on or after June 1, 1904, shall be determined in accordance with the following formula and table:

$$\text{Formula: } a = .2074 \times \frac{W}{P}.$$

Where  $a$  = area of safety valve, in square inches, per square foot of grate surface.

$W$  = pounds of water evaporated per square foot of grate surface per hour.

$P$  = absolute pressure per square inch = working gauge pressure + 15.

From which formula the areas required per square foot of grate surface in the following table are found by assuming the different values of  $W$  and  $P$ .

The figures ( $a$ ) in table multiplied by square feet of grate surface give the area of safety valve or valves required.

When this calculation results in an odd size of safety valve, use next larger standard size.

## EXAMPLES.

(II, 26)

Boiler pressure = 75 pounds per square inch (gauge).

2 furnaces: Grate surface = 2 (No.)  $\times$  5 feet 6 inches (long)  $\times$  3 feet (wide) = 33 square feet.

Water evaporated per pound of coal = 8 pounds.

Coal burned per square foot grate surface per hour =  $12\frac{1}{2}$  pounds.

Evaporation per square foot grate surface per hour =  $8 \times 12\frac{1}{2} = 100$  pounds.

Hence  $W = 100$  and gauge pressure = 75 pounds.

From table the corresponding value of  $a$  is .230 square inch.

Therefore area of safety valve =  $33 \times .23 = 7.59$  square inches.

For which the diameter is  $3\frac{1}{8}$  inches nearly.

Boiler pressure = 215 pounds.

6 furnaces: Grate surface = 6 (No.)  $\times$  5 feet 6 inches (long)  $\times$  3 feet 4 inches (wide) = 110 square feet.

Water evaporated per pound coal = 10 pounds.

Coal burned per square foot grate surface per hour = 30 pounds.

Evaporation per square foot grate surface per hour =  $10 \times 30 = 300$  pounds.

Hence  $W = 300$ , gauge pressure = 215, and  $a = .270$  (from table).

Therefore area of safety valve =  $110 \times .270 = 29.7$  square inches, which is too large for one valve. Use two.

$\frac{29.7}{2} = 14.85$  square inches. Diameter =  $4\frac{1}{2}$  inches.

To determine the area of a safety valve for boiler using oil as fuel or for boilers designed for any evaporation per hour:

Divide the total number of pounds of water evaporated per hour by any number of pounds of water evaporated per square foot of grate surface per hour ( $W$ ) taken from, and within the limits of, the table. This will give the equivalent number of square feet of grate surface for boiler for estimating the area of valve. Then apply the table as in previous examples.

## EXAMPLE.

Required the area of a safety valve for a boiler using oil as fuel, designed to evaporate 8,000 pounds of water per hour, at 175 pounds gauge pressure.

Make  $W = 200$ .

$\frac{8,000}{200} = 40$ , the equivalent grate surface, in square feet.

For gauge pressure = 175 pounds and  $W = 200$ , from table,  $a = .218$  square inch.  $.218 \times 40 = 8.72$  square inches, the total area of safety valve required for this boiler, for which the diameter is  $3\frac{5}{8}$  square inches nearly.

*Table of area of safety valves required per square foot of grate surface for different pressures and rates of evaporation.*

These figures represent evaporation in pounds per square foot of grate surface per hour (W)=pounds water evaporated per pound coal×pounds coal burned per square foot of grate surface per hour.														
P. absolute pressure per square inch.	Gauge pressure per square inch.													
100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
The figures below give $a$ , the area in square inches required per square foot of grate surface at the above rate of evaporation.														
65	50	.319	.383	.447	.510	.574	.638	.702	.765	.829	.893	.956		
70	55	.296	.355	.414	.474	.533	.592	.652	.711	.769	.828	.888		
75	60	.276	.332	.387	.442	.497	.552	.608	.663	.718	.773	.829		
80	65	.259	.311	.363	.415	.466	.518	.570	.622	.674	.726	.778		
85	70	.244	.292	.341	.390	.438	.487	.536	.585	.634	.682	.731		
90	75	.230	.276	.322	.368	.414	.460	.506	.552	.598	.644	.690		
95	80	.218	.262	.305	.349	.392	.436	.479	.523	.567	.610	.654		
100	85	.207	.249	.290	.332	.373	.414	.456	.497	.538	.580	.622		
105	90	.197	.236	.276	.316	.355	.394	.434	.473	.513	.552	.592		
110	95	.188	.226	.264	.301	.339	.377	.414	.452	.489	.527	.565		
115	100	.180	.216	.252	.288	.324	.360	.396	.432	.468	.504	.540		
120	105	.172	.207	.241	.276	.311	.345	.379	.414	.448	.483	.517		
125	110	.166	.199	.232	.265	.298	.331	.364	.397	.431	.463	.497		
130	115	.160	.192	.223	.255	.287	.319	.351	.383	.415	.447	.479		
135	120	.153	.184	.215	.246	.276	.307	.337	.368	.398	.429	.460		
140	125	.148	.177	.207	.237	.266	.296	.325	.355	.385	.414	.444		
145	130	.143	.172	.201	.229	.258	.287	.315	.344	.372	.401	.430		
150	135	.138	.166	.194	.222	.249	.277	.304	.332	.360	.387	.415		
155	140	.134	.160	.187	.214	.241	.268	.294	.321	.348	.375	.401		
160	145	.130	.156	.181	.207	.233	.259	.285	.311	.337	.363	.389		
165	150	.126	.151	.176	.201	.226	.251	.276	.301	.326	.352	.378		
170	155	.122	.146	.171	.195	.219	.244	.268	.292	.317	.341	.366		
175	160	.118	.142	.166	.189	.213	.236	.260	.284	.308	.331	.355		
180	165	.115	.138	.161	.184	.207	.230	.254	.277	.300	.323	.346		

The figures below give *a*, the area in square inches required per square foot of grate surface at the above rate of evaporation.

185	170	.112	.135	.157	.179	.202	.224	.247	.269	.291	.314	.336	.358	.386	.414	.437	.466
190	175	.109	.131	.153	.175	.196	.218	.240	.262	.284	.306	.328	.350	.373	.395	.417	.440
195	180	.106	.128	.149	.170	.191	.213	.234	.255	.277	.298	.319	.340	.362	.383	.404	.426
200	185	.104	.124	.145	.166	.187	.207	.228	.249	.270	.290	.310	.330	.350	.370	.390	.410
205	190	.101	.121	.142	.162	.182	.202	.223	.243	.263	.283	.303	.323	.343	.363	.383	.403
210	195	.099	.119	.138	.158	.178	.198	.217	.237	.257	.277	.297	.316	.336	.356	.376	.396
215	200	.096	.116	.135	.154	.173	.193	.212	.231	.250	.269	.289	.308	.327	.347	.366	.386
220	205	.094	.113	.132	.151	.170	.189	.208	.226	.245	.264	.283	.302	.321	.340	.358	.378
225	210	.092	.110	.129	.147	.166	.184	.203	.221	.240	.258	.276	.295	.314	.332	.350	.369
230	215	.090	.108	.126	.144	.162	.180	.198	.216	.235	.253	.270	.289	.307	.325	.343	.362
235	220	.088	.106	.124	.141	.159	.176	.194	.212	.229	.247	.264	.282	.300	.318	.336	.354
240	225	.086	.104	.121	.138	.155	.173	.190	.207	.225	.242	.259	.276	.294	.311	.329	.347
245	230	.085	.102	.119	.135	.152	.170	.186	.203	.220	.237	.254	.271	.288	.305	.322	.340
250	235	.083	.100	.117	.133	.149	.167	.183	.199	.216	.233	.249	.266	.282	.299	.315	.332
255	240	.081	.098	.114	.130	.146	.163	.179	.195	.211	.228	.244	.261	.277	.293	.309	.325
260	245	.080	.096	.112	.128	.144	.160	.176	.192	.208	.224	.240	.255	.271	.287	.303	.319
265	250	.078	.094	.110	.125	.141	.157	.172	.188	.203	.219	.235	.250	.266	.282	.298	.314
270	255	.077	.092	.107	.123	.138	.153	.169	.184	.199	.215	.230	.245	.261	.276	.291	.306
275	260	.075	.090	.105	.121	.136	.151	.166	.181	.196	.211	.226	.241	.256	.271	.286	.301
280	265	.074	.089	.104	.118	.133	.148	.163	.178	.192	.207	.222	.237	.251	.266	.281	.296
285	270	.073	.087	.102	.116	.131	.146	.160	.175	.189	.204	.218	.233	.247	.262	.276	.291
290	275	.072	.086	.100	.114	.129	.143	.157	.172	.186	.200	.214	.228	.242	.257	.271	.286
295	280	.070	.084	.098	.112	.127	.141	.154	.169	.182	.196	.210	.224	.238	.253	.267	.281
300	285	.069	.083	.096	.110	.124	.138	.151	.166	.179	.193	.207	.221	.235	.249	.263	.277
305	290	.068	.082	.095	.109	.122	.136	.149	.163	.177	.190	.204	.217	.231	.245	.258	.272
310	295	.067	.080	.093	.107	.120	.134	.147	.160	.174	.187	.201	.214	.227	.241	.254	.268
315	300	.066	.079	.092	.105	.118	.132	.145	.158	.171	.184	.197	.210	.223	.237	.250	.264



(II, 26)

Any spring-loaded safety valve constructed so as to give an increased lift by the operation of steam after being raised from its seat, or any spring-loaded safety valve constructed in any other manner, so as to give an effective area equal to that of the aforementioned spring-loaded safety valve, may be used in lieu of the common lever-weighted valve on all boilers on steam vessels, and each spring-loaded valve shall be supplied with a lever that will raise the valve from its seat a distance of not less than that equal to one-eighth of the diameter of the valve opening; but in no case shall any spring-loaded safety valve be used in lieu of the lever-weighted safety valve without first having been approved by the Board of Supervising Inspectors.

The valves shall be so arranged that each boiler shall have at least one separate safety valve, unless the arrangement is such as to preclude the possibility of shutting off the communication of any boiler with the safety valve or valves employed. This arrangement shall also apply to lock-up safety valves when they are employed.

The use of two safety valves may be allowed on any boiler, provided the combined area of such valves is equal to that required by rule for one such valve. Whenever the area of a safety valve, as found by the rule of this section, will be greater than that corresponding to 6 inches in diameter, two or more safety valves, the combined area of which shall be equal at least to the area required, must be used.

Where escape pipes for safety valves are installed in steam vessels after July 1, 1910, the area of such pipes shall equal the combined area of all valves to which such pipes are connected.

The seats of all safety valves shall have an angle of inclination of 45 degrees to the center lines of their axes.

Hereafter no safety valves having a set screw arrangement on top of the valve casing, designed to hold the valve down while the hydrostatic pressure is being applied, shall be allowed. On such valves now in use, inspectors shall require the set screws to be taken out and the hole permanently closed. This does not apply to any safety valve whose form of construction is such that the hole for the set screw or bolt is securely closed when the valve is locked.

#### LEVER SAFETY VALVES.

All common lever safety valves to be hereafter applied to the boilers of steam vessels must be constructed in material, workmanship, and principle according to the requirements for a safety valve referred to in this section. When this construction of a safety valve is applied to the boilers of steamers navigating rough waters, the link may be connected direct with the spindle of the valve: *Provided, always, That the fulcrum or points upon which*

the lever rests are made of steel, knife or sharp edged, and hardened; in this case the short end of the lever should be attached directly to the valve casing. In all cases the link requires but a slight movement not exceeding one-eighth of an inch. (II, 26)

#### REQUIREMENTS IN CONSTRUCTION OF LEVER SAFETY VALVES.

All the points of bearing on lever must be in the same plane.

The distance of the fulcrum must in no case be less than the diameter of the valve opening.

The length of the lever shall not exceed the distance of the fulcrum multiplied by ten.

The width of the bearings of the fulcrum must not be less than three-fourths of 1 inch.

The length of the fulcrum link shall not be less than 4 inches.

The lever and fulcrum link must be made of wrought iron or steel, and the knife-edged fulcrum points and bearings for the points must be made of steel and hardened. But the chambers and saddle flanges of this and all other types of safety valves attached to boilers may be made of cast iron or other suitable material.

The valve, valve seat, and bushing for the stem or spindle must be made of composition (gun metal) when the valve is intended to be attached to a boiler using salt water; but when the valve is to be attached to a boiler using fresh water and generating steam of a high pressure the parts named, with the exception of the bushings for the spindle, may be made of cast iron. On safety valves constructed after June 30, 1905, neither the valve nor the valve seats shall be of cast iron.

The valve must be guided by its spindle, both above and below the ground seat and above the lever, through supports either made of composition (gun metal) or bushed with it.

The spindle shall fit loosely in the bearings or supports.

When the valve is intended to be applied to the boilers of steamers navigating rough waters, the fulcrum link may be connected directly with the spindle of the valve; providing always that the knife-edged fulcrum points are made of steel and hardened, and that the vertical movement of the valve is unobstructed by any lateral movement.

In all cases the weight must be adjusted on the lever to the pressure of steam allowed in each case by a correct steam gauge attached to the boiler. The weight must then be securely fastened in its position and the lever marked for the purpose of facilitating the replacing of the weight should it be necessary to remove the same, and in no case shall a line or any other device be attached to the lever or weight except in such a manner as will enable the engineer to raise the valve from its seat.

## (II)

## SEA COCKS.

§ 4418, R. S.

27. All sea valves or cocks secured to the skin of the vessel by bolts and connected to the engines or boilers by pipes shall be arranged so as to be accessible at all times, so that if a leak or defect occurs it can be reached. All parts of said valves except the chamber shall be made of brass or bronze when used on wooden-hull vessels navigating salt water; but in the case of iron-hull vessels the brass or bronze bolts may be dispensed with.

## STOP VALVES.

§ 4418, R. S.

28. On all boilers built after July 1, 1896, a stopcock or valve shall be placed between all check valves and boiler, and between all steam and water pipes and the boiler.

All boiler connections of over 2 inches in diameter, except the connections for safety valves, shall be permanently flanged and bolted directly to the boiler. Where the connecting point on the boiler is of circular form, distance pieces shall be allowed in order to square the point of attachment of the flanged fittings, but no such distance piece shall be allowed to exceed 6 inches in length on its shortest side.

## WOODWORK FROM BOILERS.

§ 4418, R. S.

29. *Externally heated boilers* shall have a clear space between the boiler and the woodwork of not less than 6 inches at the sides and 4 inches at the top.

*Internally heated boilers* shall have a clear space between the boiler and the woodwork of not less than 4 inches at the sides and 4 inches at the top.

All wood work or other ignitable substance approaching within 12 inches of the boiler or smokestack (unless such boiler or smokestack is covered with good nonconducting material) shall be suitably sheathed with metal over noncombustible material, and it shall be the duty of the inspectors to see that all woodwork or other ignitable substance in or around the fireroom is properly protected by metal or asbestos sheathing.

All boilers hereafter placed in wooden steamers shall have a clear space of at least 8 inches between the under side of the cylindrical shell and the floor or keelson; and on all other steamers the boilers shall be so placed as to permit of proper inspection of the under side thereof.

All boilers shall have a clear space at back and ends. When located in close proximity to wooden bulkheads the space between boiler or boilers and bulkheads shall be not less than 2 feet; with iron or steel bulkheads, not less than 16 inches.

## MANHOLES.

(II)

30. Manhole openings in front head of externally fired boilers, under the flues, as required by section 4434, Revised Statutes of the United States, shall be of dimensions of not less than 8 by 12 inches in the clear. It is also further provided that all boilers shall have a manhole opening above the flues or tubes where practicable for use, and also such openings shall be of the following dimensions: § 4418, R. S.

Boilers over 40 inches in diameter shall have an opening not less than 10 by 16 or 11 by 15 inches in the clear, except boilers 40 inches in diameter of shell and under shall have an opening not less than 9 by 15 inches in the clear in manholes.

## WESTERN RIVER BOILERS.

## HEADS.

31. All heads employed in the construction of cylindrical externally fired boilers for steamers navigating the Red River of the North and rivers whose waters flow into the Gulf of Mexico shall have a thickness of material as follows: §§ 4418, 4434, R. S.

For boilers having a diameter—

- Over 32 inches and not over 36 inches, not less than  $\frac{1}{8}$  inch.
- Over 36 inches and not over 40 inches, not less than  $\frac{3}{16}$  inch.
- Over 40 inches and not over 48 inches, not less than  $\frac{1}{4}$  inch.
- Over 48 inches, not less than  $\frac{5}{16}$  inch.

The heads of steam and mud drums of such boilers shall have a thickness of material of not less than half an inch; pressure to be determined by formula for flatheads.

## FLUES.

Local inspectors, in determining the distance between the flues and the shells of externally fired boilers, under provisions of section 4434, Revised Statutes of the United States, shall take the measurements from the plate in the flue to the plate in the shell.

## WATER-TUBE AND COIL BOILERS.

32. Duplicate blue prints or drawings of water-tube and coil boilers, with their specifications, must be submitted for approval to the Board of Supervising Inspectors (under section 4429, R. S. U. S.) and the design approved by said Board, before the boilers will be allowed to be used on any vessel coming under the jurisdiction of the Board of Supervising Inspectors. After the approval of the design by the said Board, one certified set of the approved blue prints or drawings shall be filed with the records of the Board of Supervising Inspectors, and one certified set with the records of the supervising inspector of each district, and one set of blue prints shall be § 4429, R. S.

- (II, 32) furnished the office of the local inspectors of the district in which the boiler is manufactured. The blue prints or drawings necessary to comply with the foregoing provisions shall be supplied by the manufacturer. Manufacturers shall furnish local inspectors of district where boilers are to be installed an affidavit certifying that the boilers are constructed in accordance with the design and specifications approved by the Board of Supervising Inspectors.

The working pressure allowable on cylindrical shells of water-tube or coil boilers, when such shells have a row or rows of pipes or tubes inserted therein, shall be determined by the following formula:

$$P = \frac{(D-d) \times T \times S}{D \times R}$$

Where P = working pressure allowable in pounds.

D = distance in inches between the tube or pipe centers in a line from head to head.

d = diameter of hole in inches.

T = thickness of plate in inches.

S = one-sixth of the tensile strength of the plate.

R = radius of shell in inches.

Where rows of tubes are pitched diagonally, each diagonal ligament shall not be less than three-fifths of each longitudinal ligament.

#### EXAMPLE.

Required the working pressure of a cylindrical shell having holes 1 inch in diameter, spaced 2 inches from center to center, in a line from head to head; material, one-half of an inch thick; diameter of shell, 20 inches; tensile strength of plate, 60,000 pounds.

Substituting values, we have

$$P = \frac{(2-1) \times .5 \times 10,000}{2 \times 10} = 250 \text{ pounds.}$$

#### PORCUPINE-TYPE BOILERS.

The formula for determining pressure on boilers of the so-called Porcupine and similar types shall be as follows:

Multiply the vertical distance between the centers of the horizontal rows of tubes in inches by one-half the diameter of shell of boiler in inches, which gives the area upon which the pressure is exerted to break a diagonal ligament, then find the sectional area of the ligament at its smallest part and multiply by one-sixth the tensile strength of the material. This result, divided by the area upon which the strain is exerted, gives the working pressure per square inch, which is as follows:  $\frac{E F T}{C D} = W$ ,

the working pressure, in which E equals width of ligament in inches, F thickness of material in inches, T one-

sixth of the tensile strength, C distance between vertical centers, and D one-half the inside diameter of the shell or central column. (II, 32)

For the boiler proposed, 30 inches diameter, five-eighths inch thick, tensile strength 60,000 pounds, 1.219 inches would be width of ligament, .625 thickness of plate, 10,000 one-sixth of tensile strength,  $3\frac{1}{4} = 3.6875$  inches, distance of vertical centers; 15 inches, one-half the diameter of shell, would be as follows: 1.219 multiplied by .625, this product multiplied by one-sixth the tensile strength, 10,000, equals 7,618.75. This product, divided by the product of 3.6875, distance between vertical centers, multiplied by 15, one-half the diameter, equals 55.3125, gives 137.7 as pressure allowed.

#### HYDROSTATIC PRESSURE.

All coil and pipe boilers hereafter made, when such boiler is completed and ready for inspection, must be subjected at the first inspection to a hydrostatic pressure double that of the steam pressure allowed in the certificate of inspection.

The use of malleable-iron or cast-steel manifolds, tees, return bends, or elbows in the construction of pipe generators shall be allowed, and the pressure of steam shall not be restricted to less than one-half the hydrostatic pressure applied to pipe generators unless a weakness should develop under such test as would render it unsafe in the judgment of the inspector making such inspection.

#### DRUMS AND HEADS.

All drums attached to coil, pipe, sectional, or water-tube boilers not already in use or actually contracted for, to be built for use on a steam vessel, and its building commenced at or before the date of the approval of this rule shall be required to have the heads of wrought iron or steel or cast steel flanged and substantially riveted to the drums or secured by bolts and nuts of equal strength with rivets, in all cases where the diameters of such drums exceed 6 inches.

Drums and water cylinders constructed with a bumped head of each or either end, any opening in the shell or heads to be reenforced as required by the rules of the board, the circumferential and horizontal seams to be welded and properly annealed after such welding is completed, and when tested with a hydrostatic pressure of at least double the amount of the steam pressure allowed may be used for marine purposes.

#### COPPER AND BRASS TUBES.

Seamless copper or brass tubes not exceeding three-fourths of an inch in diameter may be used in the construction of water-tube boilers or generators when liquid fuel is used. There may also be used in their construction

- (II, 32) copper or brass steam drums not exceeding 14 inches in diameter, of a thickness of material not less than five-eighths of an inch, and copper or brass steam drums 12 inches in diameter and under having a thickness of material of not less than one-half inch. All tubes and drums referred to in this paragraph shall be made from ingots or blanks drawn down to size without a seam. Water-tube boilers or generators so constructed may be used for marine purposes with none other than liquid fuel.

**WELDING AND REENFORCING BY THE ELECTRIC, OXY-  
ACETYLENE, OR OTHER PROCESSES.**

- <sup>§§</sup> 4405, 4418, R. S. 33. Calking edges may be reenforced on stayed surfaces, and at either end of corrugated furnaces.

Cracks in plates in stayed surfaces may be repaired, cracks not to exceed the distance from one stay to the next, or in any case not to exceed 10 inches.

Plates in stayed surfaces where reduced in thickness from corrosion over areas not exceeding 100 square inches may be reenforced, the stays and brace rivets to be extended so they will go actually through the plate and reenforcing.

Cracks in corrugated furnaces, either circumferential or lengthwise, not exceeding 3 inches in length, may be repaired by these processes.

No welding shall be allowed on the shell plates of boilers or other plates subject to tensile strain.

Where cracks are to be repaired by welding, the same are to be cut out, and holes drilled entirely through the plate at each extreme end of the crack, except small cracks from rivet to calking edge.

No repair work by any welding process will be allowed until coupons showing the character of the work proposed to be done by the applicant have been tested and submitted, together with an explanation and report of the test, to the local inspectors of the district where the work is being done. The local inspectors will then satisfy themselves whether or not such process can be used with safety on the boilers of steam vessels.

In every case where repairs are to be made by these processes on the boilers of steam vessels subject to the inspection of this service, the parties making the repairs are required to notify the office of the local inspectors, in writing, giving a full detailed description of the repairs to be made, the location of the vessel, and the time the repairs are to be begun, so that inspection may be had prior to and during the time the work is being done.

The application for permission to use this process on boiler repairs of any particular vessel implies a guarantee on the part of the applicant that the work shall, in material, flux, and workmanship, be equal to that of the samples furnished.

# RULE III.—BOATS, RAFTS, BULKHEADS, AND LIFE-SAVING APPLIANCES.

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## LIFEBOATS.

## DRAWINGS, SPECIFICATIONS, NAME PLATE.

§ 4405, R. S.

1. Builders of lifeboats shall furnish the Supervising Inspector General with drawings and specifications showing and explaining the construction of the same, and the physical characteristics (tensile strength and ductility) of the metal used. They shall also affix a plate or other device to each boat, having thereon the builder's name, number of boat, date of construction of boat, cubical contents of boat, and number of persons said boat will carry, as determined by the rules of the Board of Supervising Inspectors.

This section shall apply to all boats built after June 30, 1905.

## CONSTRUCTION.

§§ 4405, 4481,  
4488, R. S.

2. All lifeboats shall be substantially built.

Metallic lifeboats of 20 feet length and under shall be constructed of metal of not less thickness than No. 18 wire gauge. Boats 20 to 24 feet in length shall have a thickness of metal not less than No. 16 wire gauge for their middle half length, and their ends of not less than No. 18 wire gauge. Boats longer than 24 feet shall be built according to specifications approved by the supervising inspector of the district in which the boats are constructed. The wire gauge numbers given in this paragraph are Birmingham standard.

The air tanks of all metallic lifeboats built after June 30, 1906, shall be provided with air-pump connections of one-half inch outside diameter, for the purpose of testing the air-tightness of said tank.

All seams and joints shall be properly double riveted.

All lifeboats shall have air-tight tanks of sufficient capacity to float boats when full of water and when loaded to allowed capacity, and such air tanks shall be tested at the original and all subsequent annual inspections, and oftener if in the opinion of the inspectors such test is necessary.

Only countersunk-headed rivets shall be used in the construction of metallic lifeboats. (III, 2)

The above provisions of this section shall take effect only as to boats constructed after June 30, 1905.

All joints of the air tanks shall be double riveted and soldered.

All metallic lifeboats hereafter built shall be furnished with an automatic plug.

Supervising inspectors of districts where lifeboats or life rafts are built shall detail an assistant or local inspector to any place where lifeboats or life rafts are being built, whose duty it shall be to carefully inspect and examine the construction of such lifeboats or life rafts, and he shall satisfy himself that such lifeboats or life rafts are constructed in accordance with the blue prints and specifications furnished by the builders. When the assistant or local inspector approves the construction of the boat or raft, he shall stamp his initials together with the letters U. S. I. on a blank space on the plate required to be affixed to the boat or raft by the builder. The initials of the assistant or local inspector shall be satisfactory evidence to all parties interested that the boat or raft has been constructed in accordance with the blue prints and specifications on file.

#### EQUIPMENTS REQUIRED ON LIFEBOATS.

3. All lifeboats shall have the following equipment: § 4405, R. S.  
A properly secured life line the entire length on each side, and such line must be festooned with a seine float in each bight, the bights to be not longer than 3 feet; at least 2 life preservers, or wooden life floats where the same are allowed by law; 1 boat painter of not less than 2½-inch manila rope (about .9 inch diameter) properly attached and of a suitable length; a full complement of oars, and 2 spare oars of suitable length; not less than 4 rowlocks and 2 spare ones, each rowlock to be attached to the boat with separate chain; 1 steering oar with rowlock or becket, or 1 rudder, with yoke and suitable yoke ropes; 1 boat hook, 1 ax, and 1 bucket with lanyard attached, and on wooden boats 2 plugs for each drain hole, attached with chain.

*Provided*, That the equipment required in lifeboats on steamers navigating the Red River of the North, rivers whose waters flow into the Gulf of Mexico, the Yukon and other similar rivers, shall be a life line with floats festooned around the boat, 2 pairs of oars, and 1 spare oar, 4 rowlocks and 1 spare rowlock, 1 boat hook and 1 life preserver or float, 1 hand ax, 2 plugs for drain hole attached with chain or lanyard, and 1 suitable painter.

Lifeboats required on ocean vessels of 150 gross tons and over shall be equipped with 2 life lines, a painter, rudder, yoke, and yoke ropes, as already specified in this section, also a full set of oars and rowlocks, 1 spare oar and rowlock, 1 steering oar, with rowlock or becket, 2 boat

- (III, 3) hooks, 1 bailer, 1 bucket; 1 lugsail, with sheet, tack, and reef earings, in a water-tight canvas bag; 1 mast and 1 yard, with necessary rigging, 1 boat compass, 1 lantern, 1 gallon can of illuminating oil, at least 1 box of matches wrapped in a waterproof package and carried in a box attached to the underside of the stern thwart, 1 breaker of fresh water of at least 15 gallons capacity, 1 sealed tin containing 25 pounds of hard bread, 1 waterproof canvas bag 6 inches diameter and 15 inches long containing palm and needles, sail twine, marline, marline spike, hatchet, smoker's flint and steel, a small bottle of spirits of turpentine for priming lantern wicks. Every such lifeboat shall also be provided with 6 night distress signals in a metallic case.

*Provided*, That 30 rations, equaling 15 pounds, of Powell's United States Army emergency ration be permitted as a substitute for the 25 pounds of hard bread required to be carried as above specified in the lifeboats of ocean vessels of 150 gross tons and over.

Distress signals, when fired by friction devices, are allowed when stowed in metal cases and protected by cotton at the end and so arranged as to be reversible before applying friction.

*Provided*, That, on all pleasure steamers and on all other steamers of over 150 gross tons, but not exceeding 750 gross tons, limited by their certificates of inspection to routes of not more than 15 miles from any harbor, on the ocean, the lifeboats of 180 cubic feet capacity and over shall be equipped as required for lifeboats on ocean vessels, and all lifeboats of less than 180 cubic feet capacity on steamers referred to in this proviso shall be equipped as required in the first paragraph of this section for all lifeboats.

Lifeboats on steamers navigating Hawaiian waters exclusively shall be exempt from the use of air tanks and the requirements of this section relating to lifeboat equipments, excepting oars.

#### LIFEBOATS ON OCEAN-TOWED BARGES.

The lifeboats required on ocean-towed barges of more than 100 tons may be either wood or metal and of at least 10 cubic feet capacity for each person carried on the barge, and as much more as the inspectors deem necessary, shall be at least 14 feet long, of proper form and construction, in good condition, provided with air tanks at least large enough to displace 40 pounds of water for every person carried by the barge, and equipped according to the first paragraph of this section.

#### HOW LIFEBOATS MUST BE CARRIED AND OVERHAULED.

§§ 4405, 4481,  
4488, R. S.

4. All lifeboats shall be fitted with such davits and gear as will enable the boats to be safely launched in less

than two minutes from the time the clearing away of the boats is begun. (III, 4)

All lifeboats on vessels carrying passengers must, if practicable, be carried under substantial davits or cranes; but if it is not practicable so to carry all the lifeboats required, the remainder must be stowed near at hand, so as to be easily and readily launched.

All boats under davits must be arranged so that they can be simultaneously launched. Each lifeboat carried under davits must be provided with two separate davits. When a single crane is properly adapted to lower a lifeboat, it may be allowed to take the place of the two davits. Such davits or cranes, and the blocks and the falls thereof, on all passenger vessels except ferryboats, must be of sufficient strength to carry the boat with its full load.

It shall be the duty of the master or officer in charge of all such vessels to see that the boat davit falls shall at all times be in readiness for immediate use, and protected from ice, and not painted, and such boat davit falls on all boats not swung out at boat drills shall be cut adrift and overhauled; and it shall be unlawful to stow in any lifeboat articles other than those required by law and regulations.

Lifeboats must be stripped, cleaned, painted, and thoroughly overhauled at least once in every year. All lifeboats shall have their cubical contents painted on the stem in black letters and figures not less than three-fourths of an inch high on a white ground.

The lifeboat referred to in the table [sec. 13, Rule III] for passenger steamers of 10 tons or under must be either carried or towed at all times when being navigated with passengers on board.

#### CARRYING CAPACITY AND SIZE OF LIFEBOATS.

5. The capacity of all lifeboats shall be determined by the following rule: Measure the length and breadth outside of the planking or plating and the depth inside at the place of minimum depth. The product of these dimensions multiplied by .6 resulting in the nearest whole number shall be deemed the capacity in cubic feet. <sup>R. S. 4481, 4488,</sup>

To determine the number of persons a boat is to carry, divide the result by 10 for ocean, lake, bay, and sound steamers, and for river steamers divide the result by 8: *Provided, however,* That such boats shall in all cases have sufficient room, free board, and stability to safely carry such number of persons, which fact must be determined by actual experiment in the water at the time of the first inspection of said boats after the passage of this rule. Where a vessel is carrying boats of different types or capacities, at least one boat of each type or capacity shall be so tested.

(III, 5)

## EXAMPLE.

The carrying capacity of a boat 20 feet in length, 6 feet in breadth, and  $2\frac{1}{2}$  feet in depth will be determined as follows:

For ocean, lake, bay, and sound steamers,

$$\frac{20 \times 6 \times 2\frac{1}{2} \times .6}{10} = \frac{180}{10} = 18 \text{ persons.}$$

For river steamers, same boat,  $\frac{180}{8} = 22$  persons.

Lifeboats required on ocean vessels of 150 gross tons and over shall be of suitable dimensions and of not less than 180 cubic feet capacity.

*Provided*, That all pleasure steamers, and all other steamers over 150 tons but not exceeding 750 tons, limited by their certificates of inspection to routes not more than 15 miles from any harbor, shall not be required to have more than one of the lifeboats to be of 180 cubic feet capacity. Nothing, however, in this proviso shall exempt any such steamer from carrying the aggregate cubic feet of lifeboat capacity provided for by the tables.

*Provided further*, That the supervising inspector of the district may, in exceptional cases, permit lifeboats of less than 180 cubic feet as a substitute for said boat on steamers where the crew is insufficient to properly handle a boat of that size, or where there is lack of space to properly carry so large a lifeboat, but in every such case the steamer must be provided with one or more lifeboats efficient in character and large enough to carry every person on board.

## LIFEBOATS REQUIRED.

§§ 4481, 4488,  
R. S.

6. *Lifeboats required on vessels of 50 gross tons or over not carrying passengers.*

All vessels of 50 gross tons or over not carrying passengers, navigated under the provisions of Title LII, Revised Statutes of the United States, shall at all times be equipped with sufficient boat capacity to carry the crew of said vessel with safety, capacity to be determined by the rules of the Board of Supervising Inspectors: *Provided*, That steamers of less than 150 tons gross, while engaged exclusively in harbor towing, may substitute one or more life rafts for the lifeboats required, when the lifeboats interfere with the practical operation of the steamer, and such substitution may be made with safety, it being understood that when such vessel engages in service other than harbor towing she must be equipped with boats as required by the rules and regulations.

7. *Boats required on vessels of less than 50 gross tons not carrying passengers.* (III)

All vessels of less than 50 gross tons, navigated under the provisions of Title LII, Revised Statutes of the United States, and not carrying passengers, must be equipped with boats or rafts as in the opinion of the inspectors may be necessary to secure the safety of all persons on board in case of disaster.

8. *Lifeboats required on vessels carrying passengers, fire boats, stern-wheel towboats. Working boat and metal lifeboat.* §§ 4481, 4488, R. S.

All vessels inspected under the provisions of Title LII, Revised Statutes of the United States, carrying passengers, shall be required to be provided with lifeboats according to the following tables: *Provided*, That no vessel shall be required to have more lifeboat capacity than sufficient to carry all the passengers and crew allowed by the certificate of inspection. And at least one lifeboat shall be of metal, unless exempted by the supervising inspector of the district where the vessel was last inspected: *Provided further*, That all such vessels of 50 gross tons and upward must have one working boat in addition to the lifeboats required: *It is further provided*, That on vessels navigating the rivers embraced in section 10 in this rule, the cubical capacity of the working boat shall be included in the cubical capacity of lifeboats required on vessels by said section: *Provided*, That all steamers that are used exclusively as fire boats and connected or belonging to a regularly organized fire department shall not be required to carry the lifeboats required by the following tables, but shall be required to carry such boats or rafts as in the judgment of the local inspectors or supervising inspectors may be necessary to carry the crew: *Provided*, That stern-wheel towboats engaged exclusively in the business of towing shall not be required to carry the boats technically known as lifeboats, described in this Rule III, or metallic lifeboats, but shall be required to carry such boats only as, in the judgment of the local inspectors, will, by their number, capacity, character, and equipment, fully provide for the safety of the crew of the vessel.

9. *Cubical capacity of lifeboats required on passenger vessels navigating rivers other than the Red River of the North, rivers whose waters flow into the Gulf of Mexico, and the Yukon River and other similar rivers, the bars and channels of which are liable to sudden changes, except vessels of 150 gross tons and under, hereinafter provided for.* § 4481, R. S.

	Cubic feet.
Vessels over 150 and not over 300 gross tons.....	360
Vessels over 300 and not over 600 gross tons.....	540
Vessels over 600 and not over 900 gross tons.....	720
Vessels over 900 and not over 1,200 gross tons.....	900
Vessels over 1,200 gross tons.....	1,080

(III)  
§ 4481, R. S.

10. *Cubical capacity of lifeboats required on passenger vessels navigating the Red River of the North, rivers whose waters flow into the Gulf of Mexico, the Yukon and other similar rivers, the bars and channels of which are liable to sudden changes, excepting vessels of 150 gross tons and under, hereinafter provided for.*

	Cubic feet.
Vessels over 150 and not over 300 gross tons.....	240
Vessels over 300 and not over 600 gross tons.....	360
Vessels over 600 and not over 900 gross tons.....	480
Vessels over 900 and not over 1,200 gross tons.....	600
Vessels over 1,200 gross tons.....	720

- §§ 4481, 4488, R. S. 11. *Cubical capacity of lifeboats required on passenger vessels navigating northwestern lakes, bays, and sounds, except vessels of 150 gross tons and under, hereinafter provided for.*

Gross tons.	Capacity of boats.	Gross tons.	Capacity of boats.
Vessels over—	Cubic feet.	Vessels over—	Cubic feet.
150 and not over 200.....	360	2,000 and not over 2,500.....	1,620
200 and not over 300.....	540	2,500 and not over 3,000.....	1,800
300 and not over 400.....	720	3,000 and not over 3,500.....	1,980
400 and not over 500.....	900	3,500 and not over 4,000.....	2,160
500 and not over 1,000.....	1,080	4,000 and not over 4,500.....	2,340
1,000 and not over 1,500.....	1,260	4,500 and not over 5,000.....	2,520
1,500 and not over 2,000.....	1,440	5,000 and not over 5,500.....	2,700

Steamers above 5,500 gross tons shall be furnished with an additional boat of not less than 495 cubic feet capacity for each additional 500 tons burden or fraction thereof.

§ 4488, R. S.

12. *Cubical capacity of lifeboats required on passenger vessels navigating oceans, except vessels of 150 gross tons and under, hereinafter provided for.*

Gross tons.	Total capacity of boats.	Gross tons.	Total capacity of boats.
Vessels over—	Cubic feet.	Vessels over—	Cubic feet.
150 and not over 200.....	540	9,500 and not over 10,000....	7,920
200 and not over 300.....	720	10,000 and not over 10,500....	8,145
300 and not over 400.....	1,080	10,500 and not over 11,000....	8,370
400 and not over 500.....	1,260	11,000 and not over 11,500....	8,595
500 and not over 1,000.....	1,620	11,500 and not over 12,000....	8,820
1,000 and not over 1,500.....	1,800	12,000 and not over 12,500....	9,045
1,500 and not over 2,000.....	2,160	12,500 and not over 13,000....	9,270
2,000 and not over 2,500.....	2,340	13,000 and not over 13,500....	9,495
2,500 and not over 3,000.....	2,700	13,500 and not over 14,000....	9,720
3,000 and not over 3,500.....	2,880	14,000 and not over 14,500....	9,945
3,500 and not over 4,000.....	3,240	14,500 and not over 15,000....	10,170
4,000 and not over 5,000.....	3,420	15,000 and not over 15,500....	10,395
5,000 and not over 5,500.....	3,870	15,500 and not over 16,000....	10,620
5,500 and not over 6,000.....	4,320	16,000 and not over 16,500....	10,845
6,000 and not over 6,500.....	4,770	16,500 and not over 17,000....	11,070
6,500 and not over 7,000.....	5,220	17,000 and not over 17,500....	11,295
7,000 and not over 7,500.....	5,670	17,500 and not over 18,000....	11,520
7,500 and not over 8,000.....	6,120	18,000 and not over 18,500....	11,745
8,000 and not over 8,500.....	6,570	18,500 and not over 19,000....	11,970
8,500 and not over 9,000.....	7,020	19,000 and not over 19,500....	12,195
9,000 and not over 9,500.....	7,470	19,500 and not over 20,000....	12,420

Vessels of over 20,000 gross tons shall be provided with an additional boat capacity of 225 cubic feet for each additional 500 gross tons, or fraction thereof.

13. *Cubical capacity of boats required on passenger vessels of 150 gross tons and under navigating oceans, lakes, bays, sounds, and rivers.* (III)  
 §§ 4481, 4488,  
 R. S.

	Cubic feet.
Vessels not over 10 gross tons.....	60
Vessels over 10 and not over 30 gross tons.....	75
Vessels over 30 and not over 50 gross tons.....	90
Vessels over 50 and not over 100 gross tons.....	135
Vessels over 100 and not over 150 gross tons.....	165

14. Not more than one-third of the lifeboat capacity required on any vessels may be substituted by its equivalent in approved life rafts or approved collapsible (fold- ing) lifeboats. § 4488, R. S.

15. *Lifeboat not required on steam vessels of 5 gross tons or less used for pleasure purposes only.* § 4488, R. S.

All open steam launches or other steam vessels of 5 gross tons or less, used for pleasure purposes only, shall not be required to carry a lifeboat.

#### LIFEBOATS AND OTHER EQUIPMENT REQUIRED ON SAIL VESSELS.

16. Local inspectors inspecting sail vessels, carrying passengers on the ocean or on the high seas, under the provisions of section 4417, Revised Statutes, as amended by the act of Congress approved March 3, 1905, shall require such sail vessels to be equipped with a life-preserver for every person on board, passengers and crew, and with lifeboats, in accordance with the requirements of the rule applying to ocean steamers carrying passengers. § 4417, R. S.

#### BOATS AND OTHER EQUIPMENT REQUIRED ON BARGES.

17. Barges carrying passengers on any routes shall have a life-preserver or float for each and every person allowed to be carried, and in addition thereto shall be supplied with 10 buckets, 2 barrels of not less than 40 gallons each, and 3 axes, 1 hand fire pump capable of discharging 100 cubic inches of water at each stroke, and sufficient length of regulation hose to reach to all parts of the vessel, and 2 yawl boats of not less than 120 feet capacity each, equipped with 4 oars each. § 4492, R. S.

All barges carrying passengers shall be inclosed by a good and substantial rail not less than 3 feet high.

#### LIFE RAFTS.

##### DRAWINGS, SPECIFICATIONS, NAME PLATE, AND HOW MARKED.

18. Builders of life rafts shall furnish the Supervising Inspector General with drawings and specifications showing and explaining the construction of the same, and the physical characteristics (tensile strength and ductility) of the metal used. They shall also affix a plate or other device to each raft, having thereon the builder's name, number of raft, date of construction of raft, cubical contents of raft, and number of persons said raft will § 4405, R. S.



(III, 18) carry, as determined by the rules of the Board of Supervising Inspectors. This paragraph shall apply to all rafts built after June 30, 1905.

There shall be stenciled in a conspicuous place on each life raft now in use the number of persons said life raft can carry, as hereinafter provided.

#### CONSTRUCTION.

§§ 4405, 4488,  
R. S.

19. All life-raft cylinders of more than 15 feet in length or of more than 16 inches in diameter shall be constructed of metal not less than No. 18 Birmingham wire gauge. No life-raft cylinders shall be of less thickness of metal than No. 20 Birmingham wire gauge.

The retaining bands which secure the cylinders to the frames shall be made in halves so that the cylinders may be detached without difficulty for the purpose of inspection, cleaning, and painting, as required by this section.

All life-raft cylinders, except those 6 feet or less in length, must be divided by water-tight bulkheads into not less than three compartments of equal lengths, and each compartment shall be provided with a suitable air-pump connection, of one-half inch outside diameter, fitted with air-tight cap.

The inspection of a metallic cylindrical life raft will include the testing of each compartment by air pressure.

Only countersunk-headed rivets shall be used in the construction of metallic life rafts.

All seams and joints shall be properly double riveted.

The above provisions of this section shall take effect only as to life rafts constructed after December 31, 1908.

The circumferential as well as the longitudinal seams of life-raft cylinders must be riveted, and on rafts constructed after June 30, 1905, shall also be soldered.

The framework connecting the cylinders of metallic life rafts must be substantially built and capable of resisting the strain which tends to break the cylinders apart when the raft is broadside on in surf or seaway.

Life rafts must be stripped, cleaned, painted, and thoroughly overhauled at least once in every year.

#### EQUIPMENTS REQUIRED ON LIFE RAFTS.

§§ 4405, 4488,  
R. S.

20. All life rafts must be equipped with a life line running entirely around the sides and ends of the raft festooned to the gunwales with a seine float in each bight, the bights to be not longer than 3 feet; 1 painter, of 2½-inch manila rope of a suitable length; not less than 4 oars of suitable size; 2 paddles, each of not less than 5 feet in length, the blade of each to be of not less area than one-half that of the blade of one of the oars of such raft; 4 rowlocks; 1 steering oar, with rowlock or becket, and 1 boat hook.

All the equipment mentioned in this section shall be kept in good condition for immediate use.

## CAPACITY OF COLLAPSIBLE BOATS, CARLEY LIFE FLOATS, AND LIFE RAFTS.

(III)

*Engelhardt collapsible boats.*

21. 12-foot boat, except when carried on davits, 17 persons. § 4488, R. S.

20-foot boat, except when carried on davits, 28 persons.

*Carley life floats.*

No. of float.	Size of float.	Diameter of tube.	Minimum number of compartments.	Number of persons carried and allowed.
		<i>Inches.</i>		
1	8 by 4 feet.....	14½		10
2	8 by 5 feet.....	16½		11
3	10 by 6 feet.....	17½		18
4	12 by 8 feet.....	20½		33
5	3 feet 6 inches by 6 feet.....	12	8	6
6	3 feet 9 inches by 6 feet 6 inches.....	13	8	7
7	4 by 7 feet.....	14	8	9
8	4 feet 6 inches by 7 feet 6 inches.....	14	10	11
9	4 feet 6 inches by 8 feet 6 inches.....	14	12	13
10	5 by 8 feet.....	14	12	13
11	.....do.....	15	12	13
12	5 by 9 feet.....	15	14	16
13	5 by 10 feet.....	15	14	17
14	6 by 10 feet.....	16		28
15	6 feet 6 inches by 10 feet 6 inches.....	17		31
16	7 by 12 feet.....	18		41
17	8 by 12 feet.....	19		45
18	9 by 14 feet.....	20		67
19	5 by 8 feet.....	14½		18
20	5 by 10 feet.....	15½		20

*Clark's life rafts.*

Length over all.	Width outside of guards.	Number of cylinders.	Diameter of cylinders.	Length of cylinders.	Number of persons carried and allowed.
<i>Ft. in.</i>	<i>Ft. in.</i>		<i>Inches.</i>	<i>Inches.</i>	
4 10	3 9	6	12	24	4
5 11	5 2	3	15	64	6
6 5½	3 6	9	11½	22	4
6 7	4 5	12	11½	23	6
7 3	4 11½	12	13	23½	8
7 3	3 9	12	12	24	6
7 3	4 10	12	12	24	8
9	4 11½	16	13	24½	10
9 2	5 2	6	15	49	10
11 4	5 3	15	16	24	15
13 1	5 6	6	15	72	15
11 4	7	20	16	24	20
13 7	9 10	30	16	23½	30

*Barstow life rafts.*

Length of tank.	Width of tank.	Depth of tank.	Number of persons carried and allowed.
<i>Feet.</i>	<i>Feet.</i>	<i>Inches.</i>	
14	6	14	36
14	5	14	36
12	5	14	23
12	4	14	25
10	4	14	24
8	4	14	16
6	4	14	12
5	3	12	8

(III, 21)

The use of the Barstow life raft is prohibited from March 20, 1909: *Provided*, That Barstow life rafts constructed or in service on or before said date may be continued in service so long as they are maintained in good condition.

*Cylinder life rafts, approved specifications.*

Length over all.	Width outside of guards.	Diameter of cylinders.	Number of persons carried and allowed.
<i>Fl. in.</i>	<i>Fl. in.</i>	<i>Inches.</i>	
16 8	6 7½	22	28
16 6	5 8	16	16
14 0	5 6	16	14
12 2	5 7	16	14
8 0	5 2	16	7

§ 4488, R. S.

22. Engelhardt collapsible lifeboats, Carley life floats, and the life rafts specified in the preceding section, of different dimensions from the foregoing, may be tested by the supervising inspector of the district in which they are made, after their specifications have been approved by the Supervising Inspector General, and allowed the number of persons which they actually carry in said trial, the Supervising Inspector General issuing a circular letter giving the rating allowed after trial of each new size.

The Engelhardt collapsible (folding) lifeboat shall be rated as a lifeboat when extended under the davits. One nest of two such lifeboats shall be allowed under one set of davits on steam vessels of 3,500 to 5,000 gross tons, and one nest of three such lifeboats shall be allowed on steam vessels of 5,000 gross tons and upward.

Engelhardt collapsible lifeboats shall be fully equipped as lifeboats as required by these rules and regulations, and shall be measured in accordance with the rules for measuring lifeboats (section 5, Rule III). The depth of the boat shall be taken from the inside of the bottom planking of the bottom. The cubical capacity thereof shall be determined by multiplying the length, breadth, and depth together, and multiplying that product by .7.

Vessels navigating waters where the average depth of the channel does not exceed 3 feet shall not be required to be equipped with lifeboats or life rafts.

**LIFE PRESERVERS.**

§ 4488, R. S.

23. Every vessel inspected under the provisions of Title LII, Revised Statutes of the United States, shall be provided with one good life preserver, having the approval of the Board of Supervising Inspectors, for each and every person carried.

Every life preserver adjustable to the body of a person shall be made of good cork blocks or other suitable material approved by the Board of Supervising Inspectors, with belts and shoulder straps properly attached, and shall be so constructed as to place the device underneath the shoulders and around the body of the person wearing

it. All such life preservers shall be not less than 52 inches in length when measured laid flat; and every cork life preserver shall contain an aggregate weight of at least  $5\frac{1}{2}$  pounds of good cork, and every life preserver shall be capable of sustaining for a continuous period of twenty-four hours an attached weight so arranged that whether the said weight be submerged or not there shall be a direct downward gravitation pull upon said life-preserver of at least 20 pounds. (III, 23)

All life preservers shall be covered with material of sufficient weight and strength to fully protect the contents, such material to be of a strength equivalent to unbleached cotton twill not less than 6 ounces in weight to a section of 30 by 36 inches. Such covering on each life preserver shall be of one piece only, and the outside longitudinal edges of the covering at the seam must be turned to a roll and closely rope-stitched. Each life preserver shall have two shoulder straps of heavy double-woven cotton tape  $1\frac{1}{2}$  inches in width. Each strap shall be made of one piece only, and such straps shall be not less than 23 inches net in length, and shall be securely attached to the covering of the life preserver by not less than four rows of stitching and at not less than two places for each strap, the rear ends of the straps to be sewed on not less than 3 nor more than 5 inches from the center of the upper edge of the jacket, measured to the center of the straps. The said shoulder straps shall be securely attached to each other by not less than four rows of stitching at the point where they cross each other on the back, the forward ends to be sewed on the jacket in such a position as to allow it to be opened out to its full length without straining the cross seizing. There shall also be on each life preserver a breast or button strap of heavy double-woven cotton tape 1 inch wide and 12 inches long, one end of which shall be securely fastened to one shoulder strap by four rows of stitching at a point 4 inches above the jacket, and the other end of such breast strap shall be doubled back 2 inches and a buttonhole worked through both parts. A button of noncorrosive material shall be securely sewed on the other shoulder strap 4 inches above the jacket. There shall also be on each life preserver a belt of heavy double-woven cotton tape  $1\frac{1}{2}$  inches wide, extending along the middle line on the outside of the jacket, securely sewed to the covering of the life preserver at not less than six places, the end blocks being left free, and the ends of the belt to extend 12 inches beyond the ends of the jacket. All thread used in the construction of life preservers must be linen of a size and strength not less than Barbour's three-cord No. 25 machine thread. All seams and other machine sewing on life preservers shall be with a short lock stitch, not less than 8 stitches to the inch.

Blocks of compressed or consolidated cork when used in life preservers must weigh in the aggregate not less than 6 pounds to each life preserver, and must be so constructed that said blocks will sustain, without disinte-

(III, 23) gration or substantial expansion, a submersion test satisfactory to the inspector examining the same, and that at the expiration of such test must have the buoyancy above required. Where the blocks of life preservers are made up of separate pieces of cork, said pieces shall be fastened with noncorrosive materials.

After the approval of this rule no life preserver shall be passed at the factory inspection which does not fulfill the foregoing requirements, but life preservers now in use or already passed at factory inspection may be used on board vessels, provided they are constructed in accordance with the laws and regulations in force up to the date of approval of this section, and are in good and serviceable condition: *Provided, however,* That nothing in this section shall be construed so as to allow the use after May 1, 1905, of life preservers made of kapok or loose granulated cork: *Provided,* That all block-cork life preservers now in use that have been approved by this Board shall be passed by the local inspectors when they are not less than 48 inches in length and have the other necessary requirements. Inspectors are further required to direct such life preservers to be distributed throughout the cabins, staterooms, berths, and other places convenient for passengers on such steamers; and there shall be a printed notice posted in every cabin and stateroom and in conspicuous places about the decks, informing passengers of the location of life preservers and other life-saving appliances, and of the mode of applying or adjusting the same. Life preservers on passenger, excursion, and ferry steamers when stowed overhead must be so supported that they can be quickly released and distributed among the passengers, and the inspector must satisfy himself as to the efficiency of the means used for such purpose by actual experiment. And when such life preservers are stowed overhead at a height greater than 7 feet from the deck below efficient means must be provided for such immediate release and distribution, to be operated by persons standing on the deck below.

The supervising inspector of the district shall detail a local or assistant inspector to any place where life preservers are manufactured, whose duty it shall be to test and examine all life-preservers manufactured at that place and satisfy himself that such life preservers are in accordance with the requirements of the Board of Supervising Inspectors. When found to be in accordance with the requirements, the inspector shall stamp them with a stamp bearing the initials of his name and the date of examination, and certifying that they have been examined and passed. When life preservers are so stamped it shall be prima facie evidence that they comply with the requirements of law and regulations as to their original construction, and they may thereafter be accepted by inspectors in their discretion, as being in accordance with the rules and regulations of the Board of Supervising Inspectors.

USE OF LOOSE GRANULATED CORK LIFE PRESERVERS AND LIFE RAFTS  
AND KAPOK LIFE PRESERVERS PROHIBITED.

(III)

24. All life rafts and life preservers made in whole or in part of loose granulated cork shall be excluded from use on all vessels. § 4488, R. S.

All kapok life preservers heretofore approved by this board shall be excluded from use on all vessels.

*Provided*, That this section shall take effect on and after May 1, 1905.

WOODEN LIFE FLOATS.

25. Vessels navigating rivers and carrying passengers shall be allowed to use wooden floats, when made as approved by the Board of Supervising Inspectors, one for each deck or steerage passenger. §§ 4481, 4482, R. S.

When wooden life floats are used in accordance with the above paragraph, their dimensions shall be not less than 4 feet in length, 14 inches in breadth, and 2 inches in thickness. The floats shall be made of well-seasoned white pine or of any other wood not exceeding white pine in weight per cubic foot.

RING BUOYS.

26. Whenever they deem it necessary for the safety of passengers or crew, inspectors may require a vessel to carry not to exceed four ring buoys, either with or without attached lines. It is recommended that ring buoys hung on a steamer's gangways have the line attached to both the vessel and the buoy, and that those hung on the superstructure have no line and be as light as is possible with the necessary buoyancy. § 4488, R. S.

LINE-CARRYING GUNS, ROCKETS, AND PROJECTILES.

27. All ocean steam pleasure vessels and ocean steam vessels carrying passengers, except vessels of 150 gross tons and under, shall be provided with at least three line-carrying projectiles and the means of propelling them, such as may have received the formal approval of the Board of Supervising Inspectors. § 4488, R. S.

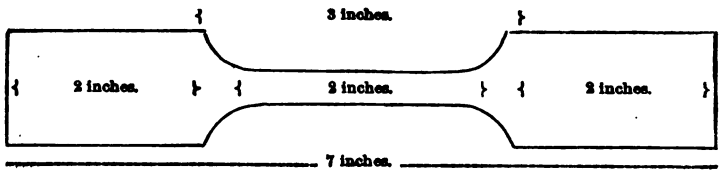
All cast bronze guns of the Lyle type, approved by the Board of Supervising Inspectors, January, 1890, for use on board of steam vessels as a means of propelling line-carrying projectiles, shall be composed of an alloy which shall have a tensile strength of not less than 52,000 pounds per square inch of section and a ductility of not less than 26 per cent, as shown by reduction of area.

All Hunt's line-carrying guns, large; Hunt's line-carrying guns, small; Hunt guns No. 2, and Lyle line-carrying guns shall be tested in the presence of an inspector or assistant inspector by firing the same three rounds. One round, at least, must carry the regular service projectile, with a service line attached, a distance of at least 1,400 feet. The other two rounds must be fired with the same

- (III, 27) charge of powder, and the projectile must have the same weight as the service projectile, but no line need be attached.

*Provided*, That when the Hunt line-carrying gun, small, is tested, the distance the projectile must carry the line need not exceed 800 feet.

At least one sample of the material shall be taken from the casting of each gun, and shall be not less than 7 inches in length, 2 inches in width,  $\frac{1}{2}$  inch in thickness, and have a section .5 by .75 inch over a length of 2 inches, according to the following diagram:



All samples shall be furnished to the supervising inspector of the district for testing and shall be accompanied by an affidavit of the manufacturer that such samples were taken from guns, each of which shall be distinctly marked, so as to be readily identified by the inspectors.

Every steel gun of approved type shall be tested in the presence of an inspector by being fired one round with its service charge of powder and regular service projectile with its service line attached.

If the line is carried without breaking or fouling, no subsequent firing is necessary, but should the first round be unsatisfactory for any reason the inspector shall require as many subsequent rounds fired as shall be necessary to assure him of the efficiency of the apparatus, before he marks the gun, carriage, and faking box or tub, with his initials.

Before any such steel gun shall be inspected, the manufacturer shall furnish the supervising inspector of the district a sample of its material, and such coupon shall be of the dimensions and form of those for bronze guns, accompanied by the same form of affidavit. The test of such coupons shall show a tensile strength of at least 65,000 pounds to the square inch of section, and an elongation of not less than 20 per cent in a length of 2 inches.

§ 4488, R. S.

28. When approved rockets are used instead of guns, there shall be, in every case, at least three of said rockets; and all steamers that are required under the law to carry line-carrying projectiles and the means of propelling them shall be supplied auxiliary thereto with at least 800 feet of 3-inch manila line for vessels of 100 to 500 gross tons and 1,500 feet of said line for steamers above 500 gross tons, such auxiliary line to be kept always ready for use in connection with the gun and rocket, and which lines shall not be used for any other purpose.

29. The test rounds required by section 27 must be fired from the gun when mounted on its own carriage, lashed as it would be in shipboard use. The line must be coiled, faked or reeled in its own faking box or reel; and gun, carriage, and line box, or reel, must all bear the same number, and must be initialed by the inspector, whose report, giving number, date, and result, will be filed in the office of the supervising inspector of the district in which the test is made. (III) § 4405, R. S.

30. The supervising inspector shall furnish the manufacturer of any Lyle or Hunt line-carrying guns a copy of the report on each gun tested and inspected, as provided in sections 27 and 29. § 4405, R. S.

#### DRILL REQUIRED WITH LINE-CARRYING GUN.

31. The master of every vessel equipped with a line-carrying gun shall drill his crew in the use thereof and fire said gun at least once in every three months, using one-half the usual charge of powder and any ordinary line of proper length. § 4405, R. S.

It shall be the duty of the inspectors, at the annual inspection, to see that these drills are entered on the log of the vessels.

#### DRAKS OR FLOATING ANCHORS.

32. Drags or floating anchors shall be constructed so as to be capable of being compactly stowed near the head of the ship. § 4488, R. S.

Steamers navigating the ocean must be provided with at least one drag, of area as follows: For steamers of 400 gross tons or under, not less than 25 superficial feet; for steamers of over 400 gross tons, the area of drag shall not be less than that determined by adding to 25 square feet 1 square foot for each additional 25 gross tons above 400 tons. Example: The area of a drag on a vessel of 1,000 tons will equal:

$$25 + \frac{1,000 - 400}{25} = 49 \text{ square feet.}$$

Steamers of over 5,000 gross tons may be equipped with two or more drags, provided the total area is not less than that required by this rule. Steamers whose routes do not extend *off anchorage* are not required to have drags or floating anchors on board.

#### EXTRA STEERING APPARATUS, LADDERS, STAIRWAYS.

33. Extra steering apparatus, consisting of relieving tackles or tiller, must be provided for all steamers. §§ 4405, 4480, 4484, R. S.

Every steamer or barge carrying passengers shall be provided with suitable ladders, where practicable for use,



- (III, 33) to enable passengers to descend conveniently to the lifeboats, such ladders to be placed near each side of the vessel.

Every steam vessel shall be provided with sufficient means of escape from the lower to the upper deck, or vice versa, and every steamer of 50 tons or over carrying passengers shall be provided with permanent stairways forward and aft, except where said stairways on towing boats would interfere with towing bitts.

#### BULKHEADS.

§ 4490, R. S.<sup>a</sup>

34. Every seagoing steamer and every steamer navigating the great Northern and Northwestern lakes carrying passengers shall have not less than three water-tight cross bulkheads. Such bulkheads shall reach to the main deck in single-decked vessels, otherwise to the deck next below the main deck. The bulkheads, however, shall in every case reach to the deck next above the load line. For wooden hulls they shall be fastened to suitable framework, which framework must be securely attached to the hull and calked. For iron hulls they shall be well secured to the framework of the hulls and strengthened by stiffeners of angle iron not less than  $3\frac{1}{2}$  by  $3\frac{1}{2}$  inches, placed not more than  $2\frac{1}{2}$  feet from center to center. And where bulkheads are more than 12 feet in depth they shall be strengthened by horizontal angle irons not less than 3 by 3 inches and spaced not less than 4 feet apart. One of the bulkheads shall be placed forward and one abaft of the engines and boilers. The bulkhead abaft the engine room shall not be placed so far aft as to make it practically useless.

The third or collision bulkhead must be placed not nearer than 5 feet from the stem of the vessel. Iron bulkheads must be made not less than one-fourth of an inch in thickness, and wooden bulkheads must be of equal strength and covered with metal plates not less than one-sixteenth of an inch in thickness.

The covering of wooden bulkheads on the forward side of the one forward of the engines and boilers, and on the after side of the one abaft the engines and boilers, shall be at the discretion of the inspectors; but no discretion is allowed as to the covering on the sides next to the engines and boilers on bulkheads built after the approval of this rule (July 12, 1906).

§ 4417, R. S.

35. On all steamers where the plans and arrangements will possibly permit, all enclosures where passengers or

<sup>a</sup> SEC. 3. That steam vessels of one hundred tons burden or under engaged in the coastwise bays and harbors of the United States may be licensed by the United States local inspectors of steam vessels to carry passengers or excursions on the ocean or upon the Great Lakes of the North or Northwest, not exceeding fifteen miles from the mouth of such bays or harbors, without being required to have the three water-tight cross bulkheads provided by section forty-four hundred and ninety of the Revised Statutes for other passenger steamers: *Provided*, That in the judgment of the local inspectors such steamers shall be safe and suitable for such navigation without danger to human life, and that they shall have one water-tight collision bulkhead not less than five feet abaft the stem of said steamer. (Act approved July 9, 1886.)

crews may be quartered, or where anyone may be employed, shall be provided with not less than two avenues of escape so located that if one of such avenues is not available another may be. The locality and arrangement of such additional means of escape shall be determined by the steamboat inspectors and the steamboat managers, as will in their judgment best carry out the purposes for which this provision was made. (III, 3

#### STEAMER'S NAME ON EQUIPMENTS.

36. All the equipments of a steamer, such as buckets, hose, axes, boats, oars, rafts, life preservers, floats, barrels, and tanks, shall be painted or branded with the name of the steamer upon which they are used. § 4405, R. S.

#### RULE IV.—FIRE APPARATUS.

	Section.
Automobiles transported on passenger steamers.....	13
Axes for passenger steamers navigating rivers only.....	1
Axes for other than passenger steamers navigating rivers only....	2
Axes for steamers navigating oceans, lakes, bays, and sounds.....	3
Axes, where located and how kept.....	4
Barrels for passenger steamers navigating rivers only.....	1
Barrels for other than passenger steamers navigating rivers only...	2
Bilge pipes required.....	14
Buckets for passenger steamers navigating rivers only.....	1
Buckets for other than passenger steamers navigating rivers only..	2
Buckets for steamers navigating oceans, lakes, bays, and sounds...	3
Cotton, baled, how bound and covered.....	5
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Pipes for carrying steam into hold, how constructed.....	7
Pipes leading from pumps, diameter of.....	10
Pumps or equivalents for certain steamers.....	8
Pumps must be of certain capacity.....	9
Pumps, rotary, allowed under certain conditions.....	11
Pumps for testing boilers.....	12
Pumps, what constitutes an equivalent for certain steamers.....	13
Pumps, steam fire, how equipped.....	14
Sounding pipe required.....	14
Spark arresters for certain western steamers.....	6
Tarpaulin, certain articles to be covered with.....	5
Water, provisions for keeping, for fire.....	3

1. All steamers navigating rivers only, carrying passengers, are required to be provided with fire buckets, barrels, and axes, as follows: §§ 4426, 4483, R. S.

Gross tons.	Barrels.	Buckets.	Axes.
All steamers not over 10 tons.....		2	1
All steamers over 10 tons and not over 25 tons.....		4	1
All steamers over 25 tons and not over 50 tons.....	1	6	2
All steamers over 50 tons and not over 100 tons.....	1	8	2
All steamers over 100 tons and not over 200 tons.....	2	18	4
All steamers over 200 tons and not over 500 tons.....	4	24	6
All steamers over 500 tons and not over 1,000 tons.....	6	35	8
All steamers over 1,000 tons.....	8	50	10

(IV, 1) *Provided*, That all steamers navigating rivers only, that are constructed wholly of iron or steel plates and whose deck houses or superstructure is constructed wholly of iron or steel plates, carrying passengers, shall not be required to carry any water barrels or tanks, as required by the preceding table.

§ 4426, R. S.

2. For freight and towing steamers navigating rivers only:

Gross tons.	Barrels.	Buckets.	Axes.
All steamers not over 10 tons.....		2	1
All steamers over 10 tons and not over 25 tons.....		4	1
All steamers over 25 tons and not over 50 tons.....	1	6	2
All steamers over 50 tons and not over 100 tons.....	1	8	2
All steamers over 100 tons and not over 200 tons.....	1	12	2
All steamers over 200 tons and not over 500 tons.....	2	15	3
All steamers over 500 tons and not over 1,000 tons.....	3	20	4
All steamers over 1,000 tons.....	4	25	5

*Provided, however*, That tanks of suitable dimensions and arrangements, or buckets in sufficient number, may be substituted for barrels on all vessels. Five buckets shall be considered as equivalent to one barrel.

*Provided*, That all freight and towing steamers navigating rivers only, that are constructed wholly of iron or steel plates and whose deck houses are constructed of iron or steel plates, shall not be required to carry any water barrels or tanks, as required by the preceding table.

§§ 4426, 4483,  
R. S.

3. All steamers navigating oceans, lakes, bays, and sounds are required to be provided with fire buckets and axes, as follows:

	Buckets.	Axes.
All steamers not over 10 tons.....	2	1
All steamers over 10 tons and not over 50 tons.....	4	1
All steamers over 50 tons and not over 200 tons.....	8	2
All steamers over 200 tons and not over 500 tons.....	15	3
All steamers over 500 tons and not over 1,000 tons.....	20	4
All steamers over 1,000 tons.....	25	5

Not more than 6 of the buckets required by this table shall be carried on the upper or boat deck.

Fire buckets, barrels, or tanks must, when practicable, be constantly filled with water and in such positions on board as shall be most convenient for extinguishment of fire.

§§ 4426, 4483,  
R. S.

4. All axes must be located so as to be readily found in time of need, must not be used for general purposes, and must be kept in good condition.

§ 4472, R. S.

5. All hay, straw, or other inflammable material carried on the open deck of any steamer carrying passengers shall be covered with a tarpaulin.

All baled cotton shall be securely bound and covered with bagging on at least three-quarters of its surface, including both ends of the bale. No bales of imported or domestic hemp shall be received on any vessel carrying

passengers unless the same are properly compressed, bound with rope, wire, or metallic bands, and covered on ends or sides, according to the several methods now practiced in foreign and domestic trade. (IV, 5)

6. All steamers on western rivers having their boilers situated so that the sparks from the fires may be driven back among combustible materials shall have a sheet-iron fender extending forward from the fire doors not less than 2 feet, at the height of the furnace fronts, and connecting with the same. § 4470, R. S.

7. The main pipes and their branches, on steamers carrying passengers or freight, to convey steam from the boilers to the hold and separate compartments of the same, except the cabins, shall not be less than 1½ inches in diameter, except on steamers employed on western rivers, constructed prior to June 30, 1905, which steamers may use branch pipes not less than three-fourths of an inch in diameter. Steam pipes of not less than three-fourths of an inch in diameter must be led to all lamp lockers, oil rooms, and like compartments, which lamp lockers, oil rooms, and compartments, in all classes of vessels, must be wholly and tightly lined with metal. All branch pipes leading into the several compartments of the hold of the vessel shall be supplied with valves, the handles distinctly marked to indicate the compartment or parts of the vessel to which they lead. § 4470, R. S.

These valves or their handles shall be placed in the most accessible part of the main deck of the vessel and so arranged that all can be inclosed in a box or casing, the door of which shall be plainly marked with the words "Steam fire apparatus."

On all oil-tank steamers the valves, instead of being located near the hatches on the upper deck, shall be all in an accessible house in which the operator is well protected from heat and smoke: *Provided*, That on oil-tank steamers a main line of steam smothering pipe of sufficient area to supply all branch pipes leading from the same to the tanks may be run the entire length of the deck, and only the main stop valve of the main line shall be required to be housed. All branch pipes shall be provided with valves which shall be left open at all times, so that the steam may enter all compartments simultaneously. Such branches as may not be required after the fire is definitely located may be shut off, in order that the entire system may be concentrated on one tank.

*Provided*, That carbonic-acid gas or other extinguishing gases or vapors may be substituted in place of steam as aforesaid and for the above-described purposes, when such gas or vapor and the apparatus for producing and distributing the same shall have been approved by the Board of Supervising Inspectors: *Provided*, That the use of such apparatus shall be allowed by law.

8. Steamers required to be provided with double-acting steam fire pumps or other equivalents for throwing water § 4471, R. S.

- (IV, 8) shall be equipped with such pumps according to their tonnage, as follows:

Steamers over 20 tons and not exceeding 150 gross tons shall have not less than 50 cubic inches pump-cylinder capacity. Steamers of over 150 gross tons and under 3,000 tons shall have not less than one-third of 1 cubic inch pump-cylinder capacity for every gross ton. Steamers of 3,000 gross tons and over shall have pump cylinder of not less than 1,000 cubic inches capacity. This rule shall apply only to pumps installed after June 30, 1907, and all pumps now approved and in use or installed before said date shall be accepted if complying with the requirements of law and regulations in force at the time of the adoption of this rule.

Upon such steamers fire mains shall be led from the pumps to all decks, with sufficient number of outlets arranged so that any part of the steamer can be reached with water with the full capacity of the pumps and by means of a single 50-foot length of hose from at least one of said outlets. On all classes of steamers every such pump shall be fitted with a gauge and a relief valve adjusted to lift 100 pounds pressure.

§ 4471, R. S.

9. Steamers are not restricted to any particular proportions for fire pumps. Any dimensions that will attain the requirements specified in section 8, or greater in capacity, may be allowed: *Provided, however,* That all hydrant connections be supplied with suitable spanners.

§ 4471, R. S.

10. The capacity of the pipes and hose leading from the pumps must in no case be less than that of the discharge opening of the pump: *Provided, however,* That the pipe and hose shall in no instance be less than 1½ inches in internal diameter.

*And provided further,* That steamers of 15 tons and under may be allowed to use hose of three-fourths of an inch internal diameter, but in no case shall it be less than the discharge opening of the pumps, it being further provided that open boats of less than 10 gross tons that are fully equipped with buckets, as required by these rules and regulations, shall not be required to carry hose.

§ 4471, R. S.

11. A rotary pump, when driven by an engine independent of the main engine, may be considered as an equivalent for the double-acting fire pump, and used as such when equal to it in efficiency and capacity.

§ 4471, R. S.

12. Any steamer having on board an independent steam pump and an auxiliary boiler suitably arranged and of sufficient strength and capacity for testing the boilers thereof; or if one of the hand fire pumps be suitably arranged and of sufficient strength and capacity for testing the boilers; or if the "doctor," so called, when arranged permanently for testing the boilers, is, in the judgment of the inspectors, suitable for the purposes intended, may be considered as having complied with the law requiring a pump for testing boilers.

13. Any steamer of 50 gross tons or under, required to have a double-acting steam fire pump, and having in use on board a "doctor," so called, may be considered as having a lawful equivalent for such a pump when such "doctor" has pipes attached to it leading to the upper and between decks, such pipes being provided with hose and valves, according to law; but the pipes and hose shall in no case be less than  $1\frac{1}{2}$  inches in internal diameter. The pumps for supplying the boilers shall in no case be considered as an equivalent for the double-acting steam fire pump on steamers above 50 gross tons. Every steamer exceeding 150 gross tons and not otherwise provided for shall be provided with one good double-acting fire pump to be worked by hand: *Provided*, That when a steam pump is equipped to work by hand the same shall be accepted as a hand fire pump. Each chamber shall be of sufficient capacity, and the stroke so regulated, that not less than 100 cubic inches of water shall be displaced by each stroke of the piston. Two smaller pumps may be allowed to take the place of the one pump of 100 cubic inches capacity provided for in this section when their combined capacity equals or exceeds 100 cubic inches. Each pump shall be placed in the most suitable part of the vessel for efficient service, having suitable, well-fitted hose to such pump long enough to reach to all parts of the vessel, kept at all times in perfect order, with brakes shipped up and hose coupled on ready for immediate use: *Provided*, That on freight steamers where the keeping of such hose coupled on interferes with the loading or unloading of cargo they may be removed during such loading or unloading.

All steamers of more than 15 tons, carrying passengers, including pleasure vessels, shall be provided with such number of good and efficient portable fire extinguishers, approved by the Board of Supervising Inspectors, as shall hereafter be prescribed, viz:

## Fire extinguishers.

Steamers of over 15 and not over 50 gross tons.....	1
Steamers of over 50 and not over 100 gross tons.....	2
Steamers of over 100 and not over 500 gross tons.....	3
Steamers of over 500 and not over 1,000 gross tons.....	6
Steamers of over 1,000 gross tons, not less than.....	8

Freight and towing steamers of over 250 tons shall be provided with chemical fire extinguishers as hereafter prescribed, viz:

## Fire extinguishers.

Steamers of over 250 and not over 500 gross tons.....	1
Steamers of over 500 gross tons.....	2

The tables of required fire extinguishers in this section are based on the capacity of the ordinary machine, which is about  $2\frac{1}{2}$  gallons. Fire extinguishers of approved types of less capacity are allowable when their total contents equal the required quantity.

All chemical fire extinguishers thus provided for shall be able to withstand a pressure of 350 pounds to the

(IV)  
§ 4471, R. S.

§ 4479, R. S.

(IV, 13) square inch, except such fire extinguishers as have no stopcock or valve between the chamber and discharge, in which case they may be used after having been tested to 150 pounds pressure to the square inch.

All steamers carrying passengers, which transport five or more automobiles or motor vehicles having attached tanks containing gasoline or any of the products of petroleum, under the provisions of section 4472, Revised Statutes, shall carry, in addition to the chemical fire extinguishers required by the preceding paragraphs, at least five chemical fire extinguishers of a type approved by the Board of Supervising Inspectors which have demonstrated before the Board a capacity for extinguishing burning gasoline, but where less than five such automobiles are transported it is only required that the steamer carry one such additional fire extinguisher for each automobile transported.

Fire extinguishers shall be located in such parts of the vessels as in the judgment of the local inspectors will be most convenient and serviceable in case of emergency, and so arranged that they may be easily removed from their fastenings. Every fire extinguisher thus provided for shall be discharged and examined at each annual inspection. Portable hand pumps with an attached carrying capacity of 5 gallons of water may be substituted for the fire extinguishers above described.

§ 4471, R. S.

14. All steam fire pumps required shall be supplied with connecting pipes leading to the hold of the vessel with stopcocks or shut-off valves attached and so arranged that such pumps may be used for pumping and discharging water overboard from the hold.

Each and every steam vessel shall be fitted with a bilge pipe leading from each compartment of the vessel and connecting with a suitably marked valve to the main bilge pump in the engine room, and each compartment of all steam vessels shall be fitted with suitable sounding pipe, the opening of which shall be accessible at all times, except that in compartments accessible at all times for examination no sounding tubes are necessary.

Steam siphons may be substituted in each compartment for the bilge pipes.

All hose required on steam vessels for fire purposes shall be tested to a pressure of 100 pounds to the square inch at each inspection, and it shall be the duty of the local inspectors at each annual inspection to see that the couplings are securely fastened to the hose by suitable external or internal clamps, and at least one length of such hose shall be kept at all times attached to each outlet of the fire main and provided with a suitable nozzle: *Provided*, That on freight steamers where the keeping of such hose coupled on interferes with the loading or unloading of cargo they may be removed during such loading or unloading.

§ 4471, R. S.

15. All pipes used as mains for conducting water from fire pumps on board steam vessels in place of hose shall be of wrought iron, brass, or copper, with wrought-iron, brass, or composition hose connections.

## RULE V.—LICENSED OFFICERS.

(V)

	Section.
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Examination, written, required for original license and renewal..	6
Examination in pilot rules required on renewal of license.....	15
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Engineers, when assistants may serve as chief.....	20
Engineers, duty of, when assuming charge of boilers.....	21
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#### LICENSES, HOW OBTAINED, AND PENALTIES RELATING THERE TO.

§§ 4438, 4445,  
R. S.

1. Before an original license is issued to any person to act as a master, mate, pilot, or engineer he must personally appear before some local board or a supervising inspector for examination; but upon the renewal of such license, when the distance from any local board or supervising inspector is such as to put the person holding the same to great inconvenience and expense to appear in person, he may, upon taking oath of office before any person authorized to administer oaths, and forwarding the same, together with the license to be renewed, to the local board or supervising inspector of the district in which he resides or is employed, have the same renewed by the said inspectors, if no valid reason to the contrary be known to them; and they shall attach such oath to the stub end of the license, which is to be retained on file in their office: *Provided, however,* That any officer holding a license, and who is engaged in a service which necessitates his continuous absence from the United States, may make application in writing for one renewal and transmit the same to the board of local inspectors, with a statement of the applicant, verified before a consul or other officer of the United States authorized to administer an oath, setting forth the reasons for not appearing in person, and upon receiving the same the board of local inspectors that originally issued such license shall renew the same for one additional term of such license, and shall notify the applicant of such renewal.

The first license issued to any person by a United States inspector shall be considered an original license, where the United States records show no previous issue to such applicant.

No original license shall be issued to any naturalized citizen on less experience in any grade than would have been required of an American by birth.

2. All licenses hereafter issued to masters, mates, pilots, and engineers shall be filled out on the face with pen and black ink instead of typewritten. Inspectors are directed, when licenses are completed, to draw a broad pen and black-ink mark through all unused spaces in the body thereof, so as to prevent, as far as possible, illegal interpolation after issue. (V)  
§ 4405, R. S.

3. Licensed officers serving under five-years' license, entitled by license and service to raise of grade, shall have issued to them new licenses for the grade for which they are qualified, the local inspectors to file in their office the old license when surrendered, with the report of the circumstances of the case, after the old license and report of the circumstances of the case shall have been reviewed by the supervising inspector of the district. § 4405, R. S.

But the grade of no license shall be raised, except as hereinafter provided, unless the applicant can show one year's actual experience in the capacity for which he has been licensed: *Provided, however,* That one year's experience as quartermaster or wheelsman, while holding a second-class pilot license, shall entitle the holder of such license to examination for raise of grade.

4. In case of loss of license, of any class, from any cause, the inspectors, upon receiving satisfactory evidence of such loss, shall issue a certificate to the owner thereof, which shall have the authority of the lost license for the unexpired term, unless in the meantime the holder thereof shall have the grade of his license raised after due examination, in which case a license in due form for such grade may be issued. § 4405, R. S.

Any license granted to a master, mate, pilot, engineer, or operator, pursuant to the provisions of Title LII of the Revised Statutes of the United States, shall be immediately revoked if, for any purpose, the holder thereof voluntarily parts with its possession or places it beyond his personal control by pledging or depositing it with another.

5. Inspectors shall, before granting an original license to any person to act as an officer of a vessel, require the applicant to make his written application upon the blank form authorized by the Board of Supervising Inspectors, which application shall be filed in the records of the inspectors' office. Inspectors shall also, when practicable, require applicants for pilot's license to have the written indorsement of the master and engineer of the vessel upon which he has served, and of one licensed pilot, as to his qualifications. In the case of applicants for original engineer's license, they shall also, when practicable, have the indorsement of the master and engineer of a vessel on which they have served, together with one other licensed engineer. § 4405, R. S.

6. No original master's, mate's, pilot's, or engineer's license shall be issued hereafter or grade increased except upon written examination, which written examination shall be placed on file as records of the office of the in- § 4405, R. S.

(V, 6) spectors issuing said license; and, before granting or renewing a license, inspectors shall satisfy themselves that the applicants can properly hear the bell and whistle signals.

§ 4405, R. S. 7. Any applicant for license who has been duly examined and refused may come before any local board for reexamination after one year has expired.

§ 4405, R. S. 8. When any person makes application for license it shall be the duty of the local inspectors to give the applicant the required examination as soon as practicable.

§ 4445, R. S. 9. Any person who has served at least one year as master, commander, pilot, or engineer of any steam vessel of the United States in any service in which a license as master, mate, pilot, or engineer was not required at the time of such service, shall be entitled to license as master, mate, pilot, or engineer, if the inspectors, upon written examination, as required for applicants for original license, may find him qualified: *Provided*, That the experience of any such applicant within three years of making application has been such as to qualify him to serve in the capacity for which he makes application to be licensed.

Officers of the Naval Militia who are applicants for license as master or pilot of steam vessels of the Naval Militia, after passing an examination for color blindness, may be examined by the inspectors as to their knowledge of the pilot rules and handling of vessels; and if the applicant be found qualified, in the judgment of the inspectors, he may be granted a special license as master, mate, or pilot on such vessels, and for no other purpose.

Any officer of the Naval Militia who is an applicant for license as chief engineer or assistant engineer of steam vessels of the Naval Militia may be examined by inspectors and granted a special license as such, and for no other purpose, if in the judgment of the inspectors he is qualified.

All licenses issued to officers of the Naval Militia provided for in the preceding paragraph of this section shall be surrendered upon the party holding it becoming disconnected from the Naval Militia by resignation or dismissal from such service; and no license shall be issued as above except upon the official recommendation of the chief officer in command of the Naval Militia station of the State in which the applicant is serving.

Masters, mates, engineers, and assistant engineers now serving as such on tenders and light vessels under the jurisdiction of the Lighthouse Establishment may be granted special licenses for the Lighthouse Service upon satisfactory evidence of their fitness for such special license. Experience in the Lighthouse Service shall be sufficient to entitle applicants to this examination, and no other experience shall be required for such special license.

10. No person holding special license (Form 878) shall be eligible for examination for a higher grade of license until such person has actually served two full seasons under the authority of his license and one additional full season in a subordinate capacity upon steamers requiring regularly licensed officers. (V)  
§ 4405, R. S.

11. Whenever an officer shall apply for a renewal of his license for the same grade, the presentation of the old certificate shall be considered sufficient evidence of his title to renewal, which certificate shall be retained by the inspectors upon their official files as the evidence upon which the license was renewed: *Provided*, That it is presented within twelve months after the date of its expiration, unless such title has been forfeited or facts shall have come to the knowledge of the inspectors which would render a renewal improper; nor shall any license be renewed more than thirty days in advance of the date of the expiration thereof, unless there are extraordinary circumstances that shall justify a renewal beforehand, in which case the reasons therefor must appear in detail upon the records of the inspectors renewing the license. § 4405, R. S.

Whenever a supervising, local, or assistant inspector of steam vessels, or any of them, shall find on board any vessel subject to the provisions of Title LII of the Revised Statutes any licensed officer under the influence of liquor or other stimulant to such an extent as to unfit him for duty, or when any licensed officer shall use abusive or insulting language to any inspector or assaults any such inspector while on official duty, the local inspectors or the supervising inspector shall immediately suspend or revoke the license of the officer so offending without further trial or investigation.

The fact of a licensed officer being under the influence of liquor in the presence of the inspector or inspectors to such an extent as to unfit him for duty while on board a vessel shall be sufficient cause for such suspension or revocation.

12. When the license of any master, mate, pilot, or engineer is revoked, such license expires with such revocation, and any license subsequently granted to such person shall be considered in the light of an original license. And upon the revocation or suspension of the license of any such officer said license shall be surrendered to the local inspectors ordering such suspension or revocation. § 4450, R. S.

13. The suspension or revocation of a joint license shall debar the person holding the same from the exercise of any of the privileges therein granted, so long as such suspension or revocation shall remain in force. § 4450, R. S.

14. When the license of any master, mate, engineer, or pilot is suspended, the inspectors making such suspension shall determine the term of its duration, except that such suspension shall not extend beyond the time for which the license was issued. § 4450, R. S.

(V)  
§§ 4439, 4442,  
R. S.

15. It shall be the duty of all inspectors, before renewing an existing license to a master or pilot of steam vessels for any waters who has not been employed as master or pilot of steam vessels on such waters during the three years preceding the application for renewal, to satisfy themselves, by an examination in writing, or orally, to be taken down in writing by the inspectors, that such officers are thoroughly familiar with the pilot rules upon the waters for which they are licensed.

§ 4405, R. S.

16. Each master and pilot of steam vessels, wherever employed, shall, when receiving his license, either original or renewal, be furnished with a pamphlet copy of the rules and regulations governing pilots and of the statutes upon which such rules are founded, applicable to the waters on which their licenses are intended to be used, as stated in the body thereof.

§ 4442, R. S.

17. Inspectors are forbidden to issue original licenses to pilots who can not read and write: *Provided, however,* That upon navigable waters of the United States newly opened to steamboat navigation, and where the only pilots obtainable are illiterate Indians or other natives, the fact that such persons can neither read nor write shall not be considered a bar to such Indians or other natives receiving license as pilot of steam vessels, provided they are otherwise qualified therefor. Inspectors having jurisdiction over the Red River of the North and rivers whose waters flow into the Gulf of Mexico are forbidden to issue original licenses to pilots for routes extending beyond these rivers.

§§ 4405, 4442,  
R. S.

18. Local inspectors having jurisdiction on the Atlantic coast, Pacific coast, or Gulf of Mexico may indorse any pilot's license for extension of route, subject to the approval of the boards having jurisdiction over the waters covered by the extension.

Whenever any pilot applies to a board of local inspectors for an extension of his pilot's route, he shall make written application, by letter, stating the extension desired, and he shall be examined, in writing, on the aids to navigation on said extension, and, if found qualified, shall receive such extension.

§ 4405, R. S.

19. Masters and pilots of steamers carrying passengers shall exclude from the pilot houses and navigator's bridge of such steamers, while under way, all persons not connected with the navigation of such steamers, except officers of the Steamboat-Inspection Service and of the Revenue-Cutter Service when upon business: *Provided,* That licensed officers of steamboats, persons regularly engaged in learning the profession of pilot, officers of the United States Navy, United States Coast and Geodetic Survey, and Lighthouse Service, and engineer officers connected with the improvement of rivers and harbors may be allowed in the pilot house or upon the navigator's bridge upon the responsibility of the officer in charge. No one shall be allowed in the pilot house of ferry

steamers, except the crew on duty there and steamboat (V, 19) inspectors.

The master of every such passenger and ferry steamer shall keep three printed copies of this section of Rule V posted in conspicuous places on such steamer, one of which shall be kept posted in the pilot house.

Such printed copies shall be furnished by the Department of Commerce and Labor to local inspectors for distribution.

## CLASSIFICATION OF ENGINEERS.

### CHIEF.

20. Chief engineers of ocean steamers.

§ 4441, R. S.

Chief engineer of condensing lake, bay, and sound steamers.

Chief engineer of noncondensing lake, bay, and sound steamers.

Chief engineer of condensing river steamers.

Chief engineer of noncondensing river steamers.

Any person holding chief engineer's license shall be permitted to act as first assistant on any steamer of double the tonnage of same class named in said chief's license.

Engineers of all classifications may be allowed to pursue their profession upon all waters of the United States in the class for which they are licensed.

### FIRST ASSISTANT.

First assistant engineer of ocean steamers.

First assistant engineer of condensing lake, bay, and sound steamers.

First assistant engineer of noncondensing lake, bay, and sound steamers.

First assistant engineer of condensing river steamers.

First assistant engineer of noncondensing river steamers.

Engineers of lake, bay, and sound steamers who have actually performed the duties of engineer for a period of three years shall be entitled to examination for engineer of ocean steamers, applicant to be examined in the use of salt water, method employed in regulating the density of the water in boilers, the application of the hydrometer in determining the density of sea water, and the principle of constructing the instrument; and shall be granted such grade as the inspectors having jurisdiction on the Great Lakes and seaboard may find him competent to fill.

Any first assistant engineer of steamers of 1,500 gross tons and over, having had actual service in that position for one year, may, if the local inspectors, in their judgment, deem it advisable, be licensed as chief engineer of lake, bay, sound, or river steamers of 750 gross tons or under, in which case license shall be issued on chief engineer's form of license, which shall be indorsed with

(V, 20) authority to act as first assistant engineer of steamers of any tonnage for which he is qualified.

Any person having had a first assistant engineer's license for two years, and having had two years' experience as second assistant engineer, shall be eligible for examination for chief engineer's license.

#### SECOND ASSISTANT.

Second assistant engineer of ocean steamers.

Second assistant engineer of condensing lake, bay, and sound steamers.

Second assistant engineer of noncondensing lake, bay, and sound steamers.

Second assistant engineer of condensing river steamers.

Any person having had a second assistant engineer's license for two years, and having had two years' experience as third assistant engineer, shall be eligible for examination for first assistant engineer's license.

#### THIRD ASSISTANT.

Third assistant engineer of ocean steamers.

Third assistant engineer of condensing lake, bay, and sound steamers.

First, second, and third assistant engineers may act as such on any steamer of the grade of which they hold license, or as such assistant engineer on any steamer of a lower grade than those to which they hold a license.

Any person holding a license as third assistant engineer and having had twelve months' experience as junior engineer, or twelve months' combined service as third assistant engineer and junior engineer, or two years' experience as oiler or water tender, or two years' combined service as oiler and water tender, since receiving said license, shall be eligible for examination for license as second assistant engineer.

Inspectors may designate upon the certificate of any chief or assistant engineer the tonnage of the vessel on which he may act.

Any assistant engineer may act as chief engineer of steamers of 100 tons and under without further examination or indorsement on his license.

§ 4441, R. S.

21. It shall be the duty of an engineer when he assumes charge of the boilers and machinery of a steamer to forthwith thoroughly examine the same, and if he finds any part thereof in bad condition, caused by neglect or inattention on the part of his predecessor, he shall immediately report the facts to the master, owner, or agent, and to the local inspectors of the district, who shall thereupon investigate the matter, and if the former engineer has been culpably derelict of his duty, they shall suspend or revoke his license.

§ 4441, R. S.

22. Before making general repairs to a boiler of a steam vessel the engineer in charge of such steamer shall report,

in writing, the nature of such repairs to the local inspector of the district wherein such repairs are to be made. (V, 22)

And it shall be the duty of all engineers when an accident occurs to the boilers or machinery in their charge tending to render the further use of such boilers or machinery unsafe until repairs are made, or when, by reason of ordinary wear, such boilers or machinery have become so unsafe, to report the same to the local inspectors immediately upon the arrival of the vessel at the first port reached subsequent to the accident or after the discovery of such unsafe condition by said engineer.

23. Whenever a steamer meets with an accident involving loss of life or damage to property, it shall be the duty of the licensed officers of such steamer to report the same in writing and in person, at the earliest opportunity, to the local board nearest the port of first arrival. If the accident happens upon the high seas or without the jurisdiction of inland waters, the board to whom the report is first made shall make the investigation, but if the accident occurs within the jurisdiction of inland waters, the report shall be transmitted to the board within whose jurisdiction the accident occurred, which board shall make the investigation, except in cases where, in the judgment of the Supervising Inspector General, better results may be obtained by another board conducting the investigation, in which case the Supervising Inspector General is authorized to direct such investigation by another board: *Provided*, That when from distance it may be inconvenient to report in person it may be done in writing only, and the report sworn to before any person authorized to administer oaths. § 4448, R. S.

24. No person shall receive an original license as engineer or assistant engineer (except for special license on small pleasure steamers and ferryboats of 10 tons and under, sawmill boats, pile drivers, boats exclusively engaged as fishing boats, and other similar small vessels) who has not served at least three years in the engineer's department of a steam vessel, a portion of which experience must have been obtained within the three years next preceding the application. § 4441, R. S.

*Provided*, That any person who has served three years as apprentice to the machinist trade in a marine stationary, or locomotive engine works, and any person who has served for a period of not less than three years as a locomotive or stationary engineer, and any person graduated as a mechanical engineer from a duly recognized school of technology, may be licensed to serve as an engineer of steam vessels after having had not less than one year's experience in the engine department of steam vessels, a portion of which experience must have been obtained within the three years preceding his application, which fact must be verified by the certificate, in writing, of the licensed engineer or master under whom the applicant has



(V, 24) served, said certificate to be filed with the application of the candidate; and no person shall receive license as above, except for special license, who is not able to determine the weight necessary to be placed on the lever of a safety valve (the diameter of valve, length of lever, distance from center of valve to fulcrum, weight of lever, and weight of valve and stem being known) to withstand any given pressure of steam in a boiler, or who is not able to figure and determine the strain brought on the braces of a boiler with a given pressure of steam, the position and distance apart of braces being known, such knowledge to be determined by an examination in writing, and the report of examination filed with the application in the office of the local inspectors, and no engineer or assistant engineer now holding a license shall have the grade of the same raised without possessing the above qualifications. No original license shall be granted any engineer or assistant engineer who can not read and write and does not understand the plain rules of arithmetic.

§§ 4426, 4441,  
R. S.

25. No person shall receive an original license as engineer of vessels of above 15 gross tons, propelled by gas, fluid, naphtha, or electric motors, carrying freight or passengers for hire, who has not served at least one year on motor boats, or in the engineer's department of steam vessels, or who has not had at least two years' experience in the construction of marine motor engines and their installation. All examinations for license as engineer of motor vessels shall be reduced to writing and filed with the application of the candidate.

Any person holding a license as engineer of steam vessels, desiring to act as engineer of motor vessels, must appear before a board of local inspectors for examination as to his knowledge of the machinery of such motor vessels, and if found qualified shall be licensed as engineer of motor vessels. Form 878, special license to engineers, shall be issued only to engineers in charge of vessels of 10 tons and under. All other licenses to engineers shall be issued on Forms 876 and 877, according to grades specified in this section.

#### MASTERS OF STEAM VESSELS.

§§ 4439, 4463,  
R. S.

There shall be a duly licensed master on board every steam vessel of more than 100 gross tons whenever such steamer is underway.

No original license as master of any steam vessel shall be issued, except under the conditions hereinafter provided:

#### MASTERS OF OCEAN STEAM VESSELS.

§ 4439, R. S.

26. Any applicant for license as master of ocean steamers must furnish satisfactory documentary evidence to the local inspectors that he has had three years' experience on ocean steamers, one year of which has been as chief mate,

or five years' experience on ocean sail vessels of 300 gross tons and upward, two years of which must have been as a licensed master of sail vessels; and he must understand navigation and be able to determine the ship's position at sea by observation of the sun, to obtain longitude by chronometer, and to determine ship's latitude by the altitude of either the sun, moon, or stars. The examination to determine his qualifications shall be in writing, which shall be kept on file in the office of the inspectors granting the license.

*Provided*, That any person holding a license as chief mate, who has had two years' service in the capacity of second mate, or watch officer actually in charge of a bridge watch since receiving such license as chief mate, shall be entitled to examination for master's license.

*It is further provided*, That where any person has actually served as a licensed third officer of ocean steamers of 3,500 gross tons and upward for five years, he shall be eligible for examination for license as master of ocean steamers.

Any person who has had three years' actual experience as master of steam vessels of 1,000 gross tons and upward on the Great Lakes and can produce documentary evidence of the fact may be examined for license as chief mate of ocean steamers, and after having had one year's actual experience as chief mate of ocean steamers of 1,000 gross tons and upward may be examined for license as master of ocean steamers, the examination to be the same as that provided for in the first paragraph of this section.

#### MASTERS OF LAKE, BAY, SOUND, AND FERRY STEAMERS.

27. No original license as master of lake, bay, and sound steamers shall be issued hereafter to any person who has not been licensed and served at least one year as first-class pilot or chief mate on such steamers, such service as pilot or chief mate to have been within the three years next preceding the application for license. § 4439, R. S.

*Provided, however*, That any person who has served three years as master of sail vessels on the Great Lakes shall be eligible for examination for master's license of steam vessels on the Great Lakes and other inland waters.

*It is further provided*, That masters of barge consorts on the Great Lakes having had three years' actual experience as such, who have been licensed as first-class pilots for one year or more, may be examined and licensed as masters of steam vessels on the Great Lakes and other inland waters, if found qualified.

*Provided further*, That any person holding a first-class pilot's license and having had one year's experience as licensed first-class pilot may be eligible for examination as master of ferry steamers.

*Provided further*, That any person who has operated under the authority of a second-class pilot's license for two

- (V, 27) years may be examined for license as master of lake, bay, sound, and ferry steamers, and, if found qualified, may receive a master's license for such steamers as in the judgment of the inspectors the applicant is qualified to command: *Provided*, That a part of the required experience must have been within the three years next preceding the application.

Whenever a master or mate desires to act in the double capacity of master and pilot, or mate and pilot, and furnishes the necessary evidence of his qualifications, the local inspectors shall indorse such pilot routes on the certificate of license.

#### MASTERS OF COASTWISE STEAMERS.

§ 4439, R. S.

28. Any person holding a license as master of lake, bay, and sound steamers may have indorsed thereon the authority allowing him to act as master of steamers upon the waters of the Atlantic coast and the Gulf of Mexico: *Provided*, That the applicant has had at least one year's experience as mate, quartermaster, or wheelsman of steam vessels upon the waters of the Atlantic coast or the Gulf of Mexico, which experience must have been obtained within the three years next preceding his application for such indorsement, and the fact must be verified by satisfactory documentary evidence to be filed in the office of the local inspectors; and the applicant shall only be subjected to such examination in writing as shall satisfy the local inspectors that he is capable of navigating such steamers. Inspectors shall state in the indorsement on the license the coastwise waters that the applicant is qualified to act upon as master. Practical service in the deck department of an ocean-going or coastwise steam yacht shall be accepted, when offered in documentary evidence by any person applying for an original license or raise of grade on ocean-going or coastwise steam vessels, as being equal to the same amount of service in any ocean-going or coastwise steam passenger vessel.

#### MASTERS OF RIVER STEAMERS.

§ 4439, R. S.

29. Inspectors shall examine all applicants for original license as master of steamers navigating rivers exclusively, which examination shall be reduced to writing and made a part of the permanent records of the office of the inspectors making such examination; and no original license shall be issued to any person to act as master of such steamers who has not, by actual service on board of such steamers for a period of not less than three years, acquired practical knowledge, skill, and experience essential in case of emergency and disaster, and in the navigation of such steamers with safety to life and property, and at least one year of service to have been within the three years next preceding the application, and such license shall entitle the holder of the same to act as master

on any river steamer of the United States, and no license as master shall be issued to any applicant who can not read and write, and who has not served at least one year as licensed mate or pilot of steam vessels. (V, 29)

The line of examination to be pursued by inspectors in examining applicants for original license as master of river steamers shall be as follows:

(1) As to his general knowledge of the duties of master of such steamers.

(2) As to his ability to handle the wheel in case of emergency or disaster.

(3) As to the knowledge of his duties and proper method of procedure in case of fire on his vessel.

(4) As to his knowledge of proper management of vessel and crew in case of collision and sinking.

(5) As to executive ability generally to manage officers and crew.

(6) As to his general knowledge and ability to navigate steamers with safety to life and property.

(7) As to his knowledge of pilot rules governing the navigation of such steamers.

(8) As to his knowledge of signals between the pilot house and engine room.

(9) As to his knowledge of signal lights and their proper position on all steam and other vessels.

(10) As to duties of master in case of fog or stormy weather, and on such other subjects in connection with the navigation of such vessels as the inspectors conducting such examination may deem proper and necessary.

#### MASTERS OF SAIL VESSELS.

Local inspectors may, upon due application and examination, license any person as master of sail vessels of 700 gross tons and upward, or of sail vessels of any tonnage carrying passengers for hire, upon receipt of satisfactory documentary evidence, to be filed in their office, that said person has been actually employed as master of sail vessels of 200 gross tons and upward, or as licensed chief mate of sail vessels of 700 gross tons and upward, for the full period of twelve months within three years next preceding the application.

#### MATES OF SAIL VESSELS.

Local inspectors may, upon due application and examination, license any person as chief mate of sail vessels of 700 gross tons and upward, upon receipt of satisfactory documentary evidence, to be filed in their office, that said person has been actually employed as chief mate of sailing vessels of 200 gross tons for one year, or as second mate on vessels of 200 gross tons for a period of two years next preceding the application.

§ 4440, R. S.

(V, 29) The examination for license as master or mate of sail vessels of 700 gross tons and upward shall be the same as required for masters and mates of steam vessels.

§§ 4439, 4442, R. S. 30. Whenever the owner of steam or sailing yachts who has had three years' experience on board such yachts applies for license to act as pilot or master of lake, bay, sound, or river steam yachts, the local inspectors shall give the applicant a written examination in regard to his knowledge in handling such vessels, and his familiarity with the lights, lighthouses, channels, buoys, obstructions, courses and distances between certain points in the waters for which he makes application for license, and shall also examine him as to his knowledge of the pilot rules of such waters, the running and anchor lights, fog signals, the use of the lead, signal bells between the engine room and pilot house, and the general rules and regulations for steam vessels. If the local inspectors are satisfied, after such examination, of the applicant's ability, they shall issue the applicant a license as pilot or master of steam yachts for the waters over which they are authorized to issue licenses.

Whenever the owner of a steam or sailing yacht of over 100 gross tons, who has had three years' experience in sailing such vessels, applies for a license authorizing him to act as master of steam yachts for coastwise and ocean navigation, the local inspectors shall examine the applicant as to his knowledge of the rules of the road, fog signals, signal lights—inland and international; the use of the lead and line; the use of the patent and chip logs, the compass, variation and deviation of the compass, the use of the drag, the use of oil during storms, bell signals between pilot house and engine room, handling of steam vessels, laws of storms, course and distance by chart, keeping the log book, middle latitude sailing, Mercator's sailing, method of obtaining latitude and longitude by dead reckoning, latitude by altitude of either the sun, moon, or stars; longitude by chronometer (time sights). Practical problems will be given in the subjects of latitude and longitude. The examination shall be in writing, which shall be kept on file in the office of the local inspectors. If said examination is satisfactory to the local inspectors, they shall issue to the applicant a master's license authorizing him to discharge the duties of master of steam yachts, either for coastwise or ocean navigation.

§ 4405, R. S.

31. Any person navigating a pleasure yacht of 15 gross tons and under, for pleasure only, holding a master's or pilot's license, is fully authorized to navigate such pleasure yacht in the inland waters of the United States without being required to report to the various boards of inspectors whose district they may be passing through.

§§ 4439, 4440, R. S.

32. Any applicant for original license to act as master or mate of steam pilot boats, or of steamers navigating the waters of the whaling grounds in the Alaskan seas, or of steamers engaged exclusively in the business of whale

fishing, or of steamers engaged in the Atlantic, Pacific, or Gulf coast fisheries, or of steam or sail vessels navigating between ports of the Hawaiian Islands, or between ports of the island of Porto Rico, must have had at least three years' experience in the deck department of such steamers, which fact must be verified by documentary evidence; and such applicant shall only be subjected to such examination as shall satisfy the inspectors that the applicant is capable of navigating such vessels: *It is provided*, That any person who has had at least five years' experience on sail vessels licensed in the fisheries of the United States, two years of which have been as master or mate of such sailing vessels, may be examined for license as master or mate of steam fishing vessels to be employed exclusively in the Atlantic, Pacific, and Gulf coast fisheries. The license issued under this section shall state in the body thereof "for coastwise only," Pacific or Atlantic coast, as the case may be, and between what ports on either of said coasts. (V, 32)

*It is further provided*, That said master's or mate's license may be indorsed as pilot on such inland waters on the above-named coasts as the local inspectors at the various ports may find the holder qualified to act on as pilot, after examination by the local inspectors, such examination to be in writing and preserved in the files of the inspectors' office.

#### MASTERS OF PASSENGER BARGES.

33. Any person applying for license as master of barges carrying passengers must have had three years' experience in the deck department of such vessels, and shall be subjected to such examination as will show his ability to handle the class of vessels for which he desires a license. § 4438, R. S.

#### CHIEF MATE OF OCEAN STEAMERS.

34. No original license as chief mate of ocean steamers shall be issued to any person who has not served at least three years in the deck department of such steam vessels, one year of such service to have been as second mate of such vessels. § 4440, R. S.

*Provided*, That any person who has had five years' experience on sail vessels of 300 gross tons and over, two years of which have been in the capacity of licensed chief mate of sail vessels of 700 gross tons and over, may be licensed as chief mate of ocean steamers.

#### SECOND MATE OF OCEAN STEAMERS.

35. No original license for second mate of ocean steamers shall be issued to any person hereafter who has not had three years' experience on such steam vessels, two years of which shall have been as watch officer or quarter-

(V, 35) master, or two of the three years' experience required may be on the school ship *St. Marys* or some other similar vessel, as indicated by his graduating certificate, or he must have had three years' experience on ocean sail vessels of 300 gross tons and over, one year of which shall have been as second mate of such sail vessels of 700 gross tons and upward: *Provided*, That any person holding a second mate's license who has had two years' experience on the same as watch officer shall be entitled to an examination for chief mate's license.

§ 4440, R. S.

36. Any first-class seaman who has had three years' experience on the deck of a sail vessel and one year's experience in the deck department of a steam vessel shall be eligible for examination for license as second mate of ocean steamers of 500 gross tons and under.

### THIRD MATE OF OCEAN STEAMERS.

§ 4440, R. S.

37. No person shall receive an original license as third mate of ocean steamers who has not had three years' experience on ocean or coastwise steam vessels or sail vessels of 300 gross tons and upward as cadet or able seaman, or two of the three years' experience required may be on the school ship *St. Marys*, or some other similar vessel, as indicated by his graduating certificate: *Provided*, That any person holding a license as third mate who has had two years' experience on said license as quartermaster on vessels of 2,500 gross tons and over shall be entitled to examination for second mate's license.

§ 4440, R. S.

38. No original license as chief mate of ocean steamers, as second mate of ocean steamers, or as third mate of ocean steamers shall be issued to any person who does not understand navigation and who is not able to determine a ship's position at sea by observation of the sun, to obtain longitude by chronometer, and to determine ship's latitude by altitude of either the sun, moon, or stars; said examination to be in writing and to be kept on file in the office of the local inspectors issuing the license.

### MATES OF COASTWISE STEAMERS.

§ 4440, R. S.

39. Any person having served a year under a license as first-class pilot of lake, bay, or sound steamers may be licensed as mate of coastwise steamers of any tonnage, in which case the license shall be issued on mate's form and indorsed with his authority as pilot.

Any person who has served for three years in the deck department of any steam vessel, one year of which service must have been in the three years next preceding the date of his application, and has had one year's experience as wheelman or quartermaster in ocean or coastwise steamers, is eligible for examination for license as mate of coastwise steamers.

Any person who has served for three years in the deck department of an ocean or coastwise steamer, one year of

such service having been within the three years next preceding the date of application, is eligible for examination for license as mate of coastwise steamers of 500 tons or under.

(V, 39)

The applicant for license as mate of coastwise steamers shall only be subjected to such examination in writing as shall satisfy the local inspectors that he is capable of navigating the steamer.

Any mate of coastwise steamers of 500 tons or under who has had one year's experience under his license may have the tonnage restriction removed.

Any person holding a license as mate of coastwise steamers who has served under such license for one year is eligible for examination for license as master of coastwise steamers.

#### MATES OF INLAND OR RIVER STEAMERS.

40. Whenever any person presents himself for examination for license as mate of inland or river steamers the local inspectors shall examine him as to his knowledge, experience, and skill in loading cargo and in handling and stowage of freight, his knowledge of the operation and handling of fire apparatus, the launching and handling of lifeboats, his knowledge of life preservers and the method of adjusting them, his ability to manage the crew and direct and advise the passengers in case of emergency, and his general familiarity with his duties in maintaining discipline and protecting the passengers, and if found qualified they shall grant him a license as such, but no such license shall be granted to any person who has not had at least two years' experience in the deck department of a steam vessel.

§ 4440, R. S.

#### FIRST-CLASS PILOTS.

41. No original license as first-class pilot shall be issued to any person hereafter who has not had three years' experience in the deck department of a steam vessel, motor vessel, sail vessel, or barge consort. The local inspectors shall, before granting a license as first-class pilot, satisfy themselves that the applicant is qualified to steer: *Provided*, That on the Mississippi and tributary rivers one year of such required experience must have been in the pilot house as steersman.

§ 4442, R. S.

#### SECOND-CLASS AND SPECIAL PILOTS.

42. No original license as second-class pilot shall be issued to any person who has not had three years' experience in the deck department of a steam vessel, motor vessel, sail vessel, or barge consort. The local inspectors shall, before granting a license as second-class pilot, satisfy themselves that the applicant is qualified to steer: *Provided*, That on the Mississippi and tributary rivers one

§ 4442, R. S.



(V, 42) year of such required experience must have been in the pilot house as steersman.

§ 4405, R. S. 43. The navigation of every steamer above 100 gross tons shall be under the control of a first-class pilot, and every such pilot shall be limited in his license to the particular service for which he is adapted. Special pilots may also be licensed for steamers of 10 gross tons and under, locally employed.

§ 4442, R. S. 44. A first-class or second-class pilot may act as master of a steamer not exceeding 100 gross tons. A second-class pilot is authorized to act as pilot in charge of a watch on any steamer when navigating inland waters.

§ 4404, R. S. 45. All passenger and ferry steamers shall, in addition to the regular pilot on watch, have one of the crew also on watch, in or near the pilot house; and this rule applies to all steamers navigating in the nighttime.

§ 4442, R. S. 46. No original license for pilot of any route shall be issued to any person, except for special license for steamers of 10 gross tons and under, who has not served at least three years in the deck department of a steamer, motor vessel, sail vessel, or barge consort, one year of which experience must have been obtained within the three years next preceding the date of application for license, which fact the inspectors may require, when practicable, to be verified by the certificate, in writing, of the licensed master or pilot under whom the applicant has served, such certificate to be filed with the application of the candidate.

§§ 4405, 4442, R. S. 47. Pilots of steam vessels, while in the discharge of their duties, must be governed by the rules of the Board of Supervising Inspectors, made for their guidance, and not by any instructions emanating from any inspector or other person.

§§ 4439, 4442, R. S. 4440. 48. No license as master, mate, or pilot of any vessel propelled in whole or in part by steam, gas, fluid, naphtha, alco-vapor, electric, or other like motors, or master or mate of sail vessels, shall be issued or renewed except on the official certificate of a surgeon of the Public Health and Marine-Hospital Service respecting the vision of the person applying for issue or renewal of license: *Provided, however,* That any person that received a license prior to the adoption of the rule demanding a visual examination may have such license renewed for daylight navigation only, provided there is no other bar to such renewal: *Provided further,* That any person holding a license as mate on steamers navigating waters flowing into the Gulf of Mexico and their tributaries issued prior to 1905 may have such license renewed without being subjected to the examination for color blindness.

§ 4405, R. S. 49. It shall be the duty of the officer in charge of every steamer carrying passengers to cause to be prepared a station bill for his own department, and one also for the engineer's department, in which shall be assigned a post or station of duty for every person employed on board such steamer in case of fire or other disaster, which sta-

tion bills shall be placed in the most conspicuous places on board for the observation of the crew. And it shall be the duty of such master, or of the mate or officer next in command, once at least in each week, to call all hands to quarters and exercise them in the discipline, and in the unlashing and swinging out of the lifeboats, weather permitting, and in the use of the fire pumps and all other apparatus for the safety of life on board of such vessel, with especial regard for the drill of the crew in the method of adjusting life preservers and educating passengers and others in this procedure and to see that all the equipments required by law are in complete working order for immediate use; and the fact of the exercise of the crew, as herein contemplated, shall be entered upon the steamer's log book, stating the day of the month and hour when so exercised; and it shall be the duty of the inspectors to require the officers and crew of all such vessels to perform the aforesaid drills and discipline in the presence of the said inspectors at intervals sufficiently frequent to assure the said inspectors by actual observation that the foregoing requirements of this section are complied with; the master shall also report monthly to the local inspectors the day and date of such exercise and drill, the condition of the vessel and her equipment, and also the number of passengers carried, and any neglect or omission on the part of the officer in command of such steamer to strictly enforce this rule shall be deemed cause for the suspension or revocation of the license of such officer.

The *general* fire-alarm signal shall be a continuous rapid ringing of the ship's bell for a period of not less than 20 seconds, and this signal shall not be used for any other purpose whatsoever.

Three copies of this section shall be furnished every steamer carrying passengers, to be framed under glass and posted in conspicuous places about the vessel.

50. It shall be the duty of the mate of every inland or river steamer carrying passengers to assign to deck or steerage passengers the space they may occupy on board during the voyage, and to supervise the stowage of freight or cargo, and see that the space set apart for passengers is not encroached upon. He shall also carefully examine all packages of freight delivered on board for shipment, with a view to detect and prevent any combustible or other dangerous articles prohibited by law being delivered on board. Three copies of this section shall be furnished every steamer to which this section applies, to be framed under glass and posted in conspicuous places about the steamer, one of which shall be on the main deck. §§ 4405, 4440,  
R. S.

51. It shall be the duty of the master of all loaded vessels to see that all hatches are properly covered and secured as soon as practicable after leaving port. Failure by the master of any vessel to observe this regulation shall be sufficient cause for suspension of his license on a charge of inattention to his duty. § 4405, R. S.

(V, 49)

## (VI)

## RULE VI.—INSPECTION OF STEAMERS.

	Section.
Annual inspection to be made only on written application.....	1
Certificates of inspection to be issued for a period of not less than one year.....	7
Certificates of inspection and license, how signed.....	6
Drawings of new vessels required.....	8
Duty of owners to notify inspectors when on dry dock.....	5
Hulls, inspection of.....	4
Inspection may be made within sixty days of expiration of current certificate.....	7
Permit to proceed to other ports for repairs, how issued.....	7
Repairs to hull or machinery, inspectors must be notified of.....	5
Steamers, inspectors may lawfully inspect.....	3

§ 4417, R. S.	1. The annual inspection of any vessel subject to the provisions of Title LII, Revised Statutes of the United States, must be made only on written application, presented to the United States local inspectors by the owner, master, or authorized agent of the vessel to be inspected. Such application must state upon its face that previous application for inspection has not been made to any other board of local inspectors or supervising inspector.
§ 4400, R. S.	2. Steam vessels employed by the Government, unless the titles of the same are actually vested in the United States, are not exempt from inspection.
§ 4417, R. S.	3. Inspectors may lawfully inspect within their respective districts, upon proper application, any vessel running upon the waters of their district the certificate of which is about to expire.
§ 4417, R. S.	4. In the inspection of the hulls of vessels, if the inspector shall not have satisfactory evidence otherwise of the soundness of the timber, he shall not give a certificate until the hull of the vessel shall be bored to his satisfaction.
§ 4417, R. S.	5. Whenever any vessel is placed upon the dock for repairs it shall be the duty of the master, owner, or agent to report the same to the board of local inspectors of that district, so that a thorough inspection may by them be made to determine what is necessary to make such vessel seaworthy if the condition or age of the vessel, in the judgment of the inspectors, renders such examination necessary.
	No repairs or alterations affecting the safety of the vessel, either in regard to hull or machinery, shall be made without the knowledge of the local inspectors. Notice of such repairs and changes is necessary, even if such work does not require the vessel to be placed in a dry dock, and even if there are no licensed officers attached to the vessel.
§ 4421, R. S.	6. Certificates of inspection signed by one local inspector only shall not be valid, nor shall the name of a regular inspector be substituted by that of any other person upon any such certificate. This rule also applies to licenses.
§§ 4421, 4456, R. S.	7. Certificates of inspection for any period less than one year shall not be issued, but nothing herein shall be construed as preventing the revocation or suspension of cer-

tificates of inspection, in case the same be allowed by law, (VI, 7) or from preventing local inspectors from inspecting vessels for renewal of certificate, upon due application in writing, at any time not exceeding sixty days of expiration of current certificate of inspection, providing the same can be done without greater expense than would be incurred if taking place when inspection is regularly due, and that such inspection shall not interfere with other inspections regularly falling due at the same time. This rule, however, is not to be construed as preventing the inspection of any vessel at an earlier period than sixty days anterior to the expiration of the vessel's certificate, when such vessel has been practically rebuilt, or when necessary "for the purpose of concentrating the work of the inspectors within certain given periods" (Department decision 7703, Aug. 17, 1886, p. 216, Manual, edition 1890) for the purpose of saving traveling expenses.

Local inspectors issuing a permit to any vessel to proceed to other ports for repairs must state upon the face of the same the conditions upon which it is granted and whether the vessel is to be allowed to carry freight or passengers, the quantity and number: *Provided, however,* That no vessel whose certificate has *expired* will be permitted to carry passengers or freight while en route to another port for repairs.

When, under section 4456, Revised Statutes of the United States, vessels obtain a permit from the local inspectors of a district to go from their district to another to make repairs, said local inspectors shall notify the supervising inspector of their district, stating the repairs to be made on said vessels. The supervising inspector shall notify the supervising inspector of the district where such repairs are to be made, furnishing him a copy of the report of the inspectors indicating the repairs ordered on said vessels.

8. On and after July 1, 1911, the owner of every new vessel of over 100 gross tons, when making application for first inspection of the vessel, must furnish the local inspectors of the district where the vessel is to be inspected drawings or blue prints, in plan and section, showing fully the general construction of the vessel, of wood, iron, or steel, including dimensions, spacing of frames, disposition of hull plates, outside and in, or of outside and inside planks, construction of decks, construction of transverse and longitudinal bulkheads and location of same, space between decks, and details of principal scarfs, and must also furnish a statement of the shapes, dimensions, and unit weights of all structural parts of the hull, and of the kinds of material of which made, including kinds of wood. A full description of the riveting of all parts of an iron or steel hull must be furnished. §§ 4405, 4417,  
R. S.

The drawings or blue prints and description of the vessel will be retained in the office of the local inspectors making the first inspection of the vessel.

## (VII)

## RULE VII.—FERRYBOATS.

	Section
Barges in tow, life-saving equipments required when carrying passengers.....	5
Bulkheads required on ferryboats.....	2
Cars on barges, doors and vestibules required to be open when transferring railroad passengers.....	5
Ferry steamers transferring cars with passengers, how equipped...	5
Ferryboats to be confined to routes specified in certificate.....	1
Ferryboats may go beyond specified route, how.....	1
Ferryboats, bulkheads required on.....	2
Lifeboats required on ferryboats.....	3
Life preservers or floats required on ferryboats.....	4

§ 4426, R. S.

1. The navigation of ferryboats must be confined to the ferry routes specified in the inspection certificate issued; but such vessels may be permitted, under excursion permits, to go beyond their authorized routes with passengers only, or without such permit, to lighten or relieve vessels in distress.

§ 4426, R. S.

2. All ferryboats of more than 75 gross tons carrying passengers for hire, whose construction is commenced after December 31, 1908, shall be supplied with a sufficient number of water-tight bulkheads to float the vessel if the largest compartment is filled with water..

§ 4426, R. S.

3. All ferryboats of 50 gross tons or over shall be equipped with such lifeboats, life rafts, outside ladders, and other means of escape, in case of disaster, as, in the opinion of the inspectors, shall meet the requirements of each particular case. But in no case shall the cubic feet of boat capacity be less than that provided in the following table:

	Cubic feet.
Ferryboats of 50 and not over 300 gross tons.....	120
Ferryboats over 300 and not over 600 gross tons.....	240
Ferryboats over 600 gross tons.....	360

*Provided*, That on ferryboats of more than 300 gross tons, one-half the boat capacity required may be substituted by its equivalent in approved life rafts.

Ferryboats of less than 50 gross tons shall be equipped with boats or rafts as in the opinion of the inspectors may be necessary in case of disaster to secure the safety of all persons on board.

§ 4426, R. S.

4. All ferryboats shall be equipped with a life preserver (or float where the same is allowed by law) for every 7 square feet of passenger deck surface on single-deck ferryboats and for every 12 square feet of such deck surface on ferryboats having more than one passenger deck, and such life preservers or floats shall be distributed in the most accessible places, where they can be reached at all times, and it shall be the duty of the local inspectors to see that all the life preservers or floats are marked with the name of the vessel having the same on board.

All ferryboats shall be provided with the same fire apparatus required on passenger steamers of equal tonnage.

§ 4492, R. S.

5. All barges in tow of steamers used for transferring persons on any lake, bay, sound, or river shall be provided

with the same life-saving appliances as required for passenger steamers. (VII, 5)

All towed barges used for transferring railroad passenger cars on any lake, bay, sound, or river, with passengers in cars, shall be required to have the same life-saving appliances as required by section 17 of Rule III.

All car ferry steamers engaged in transferring passenger cars, with passengers in cars, shall be equipped as ferry-boats, excepting that the number of life preservers required shall equal the number of persons carried: *Provided*, That where wooden life floats are allowed by law they may be used instead of life preservers.

It shall be the duty of the master of any such barge or steamer to see that all of the doors of the cars are unlocked and vestibules of the cars are open while the same are on the barge or steamer, to allow the persons so carried free egress at all times.

#### RULE VIII.—EXCURSION STEAMERS AND BARGES.

	Section.
Barges, excursion, life-saving equipments required on.....	4
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Lifeboats, when required.....	3
Mate and member of crew in charge of decks.....	6
Officers required.....	5
Passenger steamers making excursions, additional equipments required on.....	2
Permits, excursion, how issued.....	1

1. If the master, agent, or owner of any passenger or ferry steamer desires a permit to engage in excursions, the inspectors, upon the written application of such master, agent, or owner, which application must be accompanied by an affidavit that the proper equipment is on board, may issue the same, stating the number of extra passengers the boat may carry with safety, the route she may run, and the kind and extra number of life-saving appliances with which she is provided. The permit, when used, must be framed under glass and exposed to the view of the passengers, in connection with the certificate of inspection. § 4466, R. S.

2. Passenger steamers making excursions on the Northern and Northwestern lakes, bays, or rivers, or on waters of the Atlantic and Pacific coasts and rivers flowing into the same, and rivers whose waters flow into the Gulf of Mexico, shall have, in addition to their regular life-saving equipments, a life preserver (or float where the same is allowed by law), made in accordance with the rules of the board, or their equivalent in other approved life-saving appliances, for each additional passenger allowed. § 4466, R. S.

3. Steamers making excursions under a permit must have at least one lifeboat or life raft, in addition to the equipment required by the tables, so carried as to best secure the safety of those on board in case of disaster. § 4466, R. S.

All barges carrying excursions under permit and in tow shall be required to carry a master, and shall also carry not less than two competent men in deck crew for each 500 persons or fraction thereof carried on the barge.

(VIII)  
§ 4492, R. S.

4. Every barge carrying passengers in tow and engaged in excursions shall be supplied with one life preserver or one float for each passenger carried, and must have ten buckets, three axes, and two yawl boats of not less than 60 cubic feet capacity each, to be carried on deck ready to be launched for immediate use, or towed in such manner as to best afford prompt relief in case of accident or disaster.

Steamers or barges carrying passengers on excursions must have their extra life-saving appliances and equipments plainly marked with the vessel's name, and must have the life preservers and floats so distributed before leaving the wharf or dock as to be at all times within easy reach of the persons carried.

§ 4426, R. S.

5. When any ferryboat leaves her ferry route to engage in excursions she shall be required to carry the same officers, crew, and equipment as required by other excursion steamers.

§ 4463, R. S.

6. On every excursion or inland passenger steamer of more than 100 tons, permitted by her certificate of inspection to carry as many as 100 passengers, there shall be a licensed mate of inland or river steamers on duty whenever passengers are on board, and such mate, when on duty, shall wear a uniform or cap which shall plainly designate him as the officer to whom is confided the care of the passengers, and on every such steamer permitted to carry as many as 500 passengers, there shall be on each deck, except on the upper deck and the deck on which the mate is on duty, a member of the crew wearing a uniform or cap designating him as in charge of the passengers on that deck.

#### RULE IX.—DUTIES OF INSPECTORS.

	Section.
Boilers inspected, number of, to be reported annually to supervising inspectors.....	4
Boiler coverings, removal of, at annual inspections.....	6
Boilers, shells of, to be examined by local inspectors.....	6
Boilers, interior of, to be examined by boiler inspector.....	7
Casualties, local board to report to supervising inspectors.....	11
Excess of steam, inspectors to prosecute for carrying.....	14
Fire apparatus to be tested by hull and boiler inspectors jointly..	10
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Local inspectors to examine the shells of boilers.....	6
Local inspectors of hulls and boilers to take indication of hydrostatic pressure.....	10
Lock-up safety valves, when to be placed on boilers.....	14
Notifications, how sent to local inspectors of adjoining districts....	3
Official records, when they may be examined.....	15
Reports, annual, of the supervising inspectors, how and to whom made.....	1
Reports of supervising and local inspectors, how and when made public.....	2
Reports, quarterly, of local inspectors, when, how, and to whom made.....	12
Reports, alphabetical list of steamers inspected, officers licensed, and when made.....	13
Sounding apparatus and hand line, deep sea, required on certain ocean steamers.....	10
Testimony, when it may be obtained through the supervising inspectors.....	5
Whistles, steam, location of.....	9

1. Each supervising inspector, in his annual report to the Board of Supervising Inspectors, is required to report the number of steamers inspected in his district, classified and alphabetically arranged, stating when built, where built, amount of tonnage, the number of masters, mates, pilots, and engineers licensed, with their grade, number of issue, number of licenses; these lists to be made on blanks to be furnished by the Department. He is also required to report all casualties, such report to be made so as to accord in form with the tabular statement published in the nineteenth annual report; also any occurrence and matters which, in his opinion, will add value to the service and interest to the report. (IX)  
§ 4410, R. S.

Each supervising inspector shall report to the Supervising Inspector General, as soon as practicable after the end of each fiscal year, the number of passengers carried on passenger and ferry steamers during the fiscal year. § 4407, R. S.

2. No supervising inspector shall make his annual report public until after the same has been presented to the Board of Supervising Inspectors, as required by section 4410, Revised Statutes; and, further, no local board, or the clerk thereof, shall make public any report without the consent of their supervising inspector or that of the Supervising Inspector General. § 4410, R. S.

3. It shall be the duty of the supervising inspectors to inform their respective local boards, in writing, of their decisions in cases of appeal. Supervising inspectors granting license to a vessel engaged in towing to carry persons in addition to its crew, under the act approved July 9, 1886, shall notify the local inspectors in whose jurisdiction the steamer receiving the permit is engaged, and the local inspectors shall keep a record of the same. § 4411, R. S.

It shall be the duty of local inspectors to notify the local inspectors of adjoining districts, through the supervising inspector, of all revocations or suspensions of licenses, and also of the names of all persons from whom licenses have been withheld, the names of all steam vessels neglecting or refusing to make repairs when ordered, and the names of all that have been refused certificates, with the reasons therefor; and once in each year local inspectors shall be supplied with a list of all licensed officers, which shall be printed in the annual report of the supervising inspectors.

4. It shall be the duty of local inspectors to report correctly at the end of the year, to the supervising inspectors, the number of boilers inspected in each of their local districts. § 4410, R. S.

5. Whenever any inspector shall find it necessary, in conducting his investigations or in the performance of any of his duties, to obtain testimony from the inspectors of other districts, he shall request the same through the supervising inspector. § 4405, R. S.

6. Local inspectors, at their annual inspections of steam boilers, shall remove from the surface of such boilers as §§ 4405, 4410  
R. S.



(IX, 6) are covered so much of said covering as may be necessary to enable them to examine parts of the boilers which can not be properly examined from the inside, and shall examine in a thorough and careful manner, when practicable, either externally or internally, all parts of the shell of every boiler; and the masters, engineers, and owners of every steam vessel shall afford every facility necessary to carry out in the most effective and efficient manner the provisions of this section, and in no case shall an intermediate inspection be deemed any part of the regular annual inspection.

§§ 4405, 4418, R. S. 7. It shall be the duty of local inspectors of boilers to thoroughly examine the interior of all boilers when it is practicable to do so, to see that the braces are in place and of proper size, and to determine whether the boilers are in good condition, before granting a certificate of inspection, such examinations to be made after the hydrostatic pressure has been applied.

§ 4405, R. S. 8. It shall also be the duty of the inspectors to compel all floating structures, such as steam elevators (propelled by their own motive power), to have their whistles located on the front side of such superstructures having an elevation higher than the pilot house of the vessels.

§ 4405, R. S. 9. All steam whistles shall be placed not less than 6 feet above the top of the pilot house of steam vessels where the height of the smokestack will admit the attachment of same below its top, when not hinged for passing under bridges, except upon steamers navigating the Red River of the North, and rivers whose waters flow into the Gulf of Mexico, and steamers of less than 100 gross tons, whose steam whistles shall be placed not less than 2 feet above the tops of their pilot houses, and all double-end ferry steamers, and steamers similarly constructed, shall have a steam whistle both fore and aft of the smoke pipe, so that the steam, when whistle is blown, can be seen from either end of steamer; and it shall be the duty of inspectors to enforce this rule at the annual inspection.

§§ 4405, 4418, R. S. 4417, 10. It shall be the duty of both the hull and boiler inspectors to be present when the boiler is being tested by hydrostatic pressure, and the hull inspector, as well as the boiler inspector, shall observe and note the indication upon the gauge.

It shall also be the duty of both the hull and boiler inspectors to examine all pumps, hose, and other fire apparatus and to see the hose is subjected to a pressure of 100 pounds to the square inch and that the hose couplings are securely fastened in accordance with these rules.

It shall be the duty of all local inspectors to require all ocean passenger or freight steamers of 500 gross tons and upward to be equipped with an efficient mechanical deep-sea sounding apparatus, in addition to the ordinary deep-sea hand lead.

§ 4405, R. S. 11. Local boards shall report forthwith to their supervising inspectors in detail all accidents of a serious charac-

ter—such as collisions, founderings, sinkings, fires—and (IX, 11)  
all other casualties of interest to or affecting the steam-  
boat service in their respective districts.

12. Local boards shall report quarterly to their super- § 4411, R. S.  
vising inspectors all cases of revocation, suspension, and  
refusal of licenses to masters, mates, pilots, and engineers,  
with the reasons therefor; all examinations into alleged  
violations of the steamboat law, with their decisions  
thereon; steamers inspected, with their class and ton-  
nage; steamers refused inspection, their class and tonnage,  
and the reasons for such refusal; steamers gone out of  
service, with their class and tonnage; the number of mas-  
ters, mates, pilots, and engineers licensed; grade of licenses  
issued during the quarters ending March 31, June 30,  
September 30, and December 31 of each year.

The quarterly reports shall be made on or immediately  
after the 5th day of January, April, July, and October in  
each year.

13. Inspectors shall, on or before the 5th day of Janu- § 4411, R. S.  
ary in each year, make alphabetical list, arranged accord-  
ing to class and grade, of names of vessels inspected dur-  
ing the year previous, with their tonnage, when and  
where built, the name and grade of masters, mates, pilots,  
and engineers licensed, together with all the events affect-  
ing the Steamboat-Inspection Service and occurring in  
their districts, and said facts shall be reported in a tabular  
form and according to blanks to be furnished by the  
Department of Commerce and Labor.

14. When it is known or comes to the knowledge of the §§ 4418, 4437,  
local inspectors that any steam vessel is or has been carry- R. S.  
ing an excess of steam beyond that which is allowed by  
her certificate of inspection, the local inspectors in whose  
district said steamer is being navigated, in addition to  
reporting the fact to the United States district attorney  
for prosecution under section 4437, Revised Statutes of  
the United States, shall require the owner or owners of  
said steamer to place on the boiler of said steamer a  
lockup safety valve that will prevent the carrying of an  
excess of steam and shall be under the control of said local  
inspectors.

On the placing of a lockup safety valve upon any boiler,  
it shall be the duty of the engineer in charge of same to  
blow or cause the said valve to blow off steam at least once  
in each watch of six hours or less, to determine whether  
the valve is in working order, and it shall be the duty of  
the master of such vessel to see that this rule is observed,  
and it shall be the duty of the master and engineer to  
report to the local inspectors any failure of such valve to  
operate.

In case no such report is made, and a safety valve is  
found that has been tampered with or out of order, the  
license of the engineer having such boiler in charge and  
the license of the master of such vessel shall be suspended  
or revoked.

(IX, 14) It shall be the duty of the local inspectors to send a copy of this rule to every steamer in their district when said copies are furnished by the department.

§ 4405, R. S.

15. All official records and official documents on file in the office of any supervising inspector or board of local inspectors, after official action thereon has been concluded, may be open to public inspection and examination: *Provided*, That such inspection or examination be made in the office to which such official records and documents belong.

#### RULE X.—MISCELLANEOUS.

	Section.
Automobiles, transportation of .....	7
Bell, alarm, required on certain steamers .....	3
Code of signals between pilot and engineer on certain waters .....	10
Cable for communication required on certain steamers .....	1
Draft of seagoing vessels to be recorded in log book .....	4
Fog bell required .....	12
Inflammable articles, certain, prohibited as stores on passenger and pleasure steamers .....	4
Lights on vessels, unauthorized, prohibited .....	14
Motor vessels to be provided with whistle blown by compressed air or other power .....	2
Oil below a certain fire test not allowed as stores on passenger vessels .....	5
Refined petroleum may be carried under certain restrictions .....	6
Refined petroleum, how to put up for shipment .....	7
Speaking tube, when required .....	1
Signals between pilot and engineer on certain waters .....	10
Searchlight, flashing of, into pilot house of passing vessels forbidden .....	11
Suction pipe, area of .....	15
Telegraph, so-called, may be used between pilot house and engine room .....	1
Telephone required between pilot house and engine room on certain steamers .....	1
Whistles blown by compressed air or other power to be used by motor vessels .....	2
Whistles, steam, unnecessary sounding of, prohibited .....	13
Watchmen and lookout for ocean steamers .....	8
Watchmen for passenger steamers .....	9

§ 4405, R. S.

1. Steamers using the gong signals between the pilot house and engine room shall have a tube, of proper size, so arranged as to return the sound of the gong to the pilot house, and must also be provided with a speaking tube or other device for the purpose of conversation between pilot house and engine room.

Nothing in the above shall be construed to prevent the use of the so-called telegraph now in use for conveying signals from the pilot house to the engine room, but in all cases where the telegraph is used the signal shall be repeated back.

On steamers where the distance is more than 150 feet between deck houses, a wire cable shall be stretched between the deck houses at all times when the vessel is loaded and being navigated, this cable to be not less than 5 feet from the deck; and there shall be attached at all times to the cable a traveler with a line of sufficient continuous length to insure its operation, in order that communication between both ends of the vessel may be

facilitated at all times: *Provided*, That, in addition to (X, 1)  
the traveler with the endless whip, as many loose rings  
with lanyards attached may be placed on the cable as  
may be deemed necessary by the master in charge of the  
vessel. Failure to have such cable stretched and trav-  
eler attached at all times when the vessel is loaded  
and being navigated shall be sufficient cause for the sus-  
pension of the license of the master or officer in charge.

On all steamers where the distance is more than 150 feet  
between perpendiculars of pilot house and forward part of  
the engine room, there shall be communication by means  
of a telephone between the pilot house and engine room,  
such telephone to be installed in lieu of a speaking tube.

2. Motor vessels of any tonnage other than steam ves- § 4405, R. S.  
sels shall be provided with a whistle to be blown by com-  
pressed air or other power, to give the necessary whistle  
signals to passing vessels.

3. All steam vessels of over 100 gross tons shall have § 4405, R. S.  
all sleeping accommodations equipped with an alarm bell  
unless there is a watchman always on duty in such apart-  
ment or the apartment is so situated and arranged that  
the inspectors consider such bell unnecessary or dan-  
gerous.

4. The master of every seagoing vessel shall, whenever § 4405, R. S.  
leaving port, enter the maximum draft of his vessel in the  
log book.

5. None of the inflammable articles specified in section § 4472, R. S.  
4472, Revised Statutes, or oil that will not stand a fire  
test of 300° Fahrenheit shall be used as stores on any  
pleasure steamer or steamer carrying passengers, except  
that vessels not carrying passengers for hire may trans-  
port gasoline or any of the products of petroleum for use  
as a source of motive power for the motor boats or  
launches of such vessels.

6. Refined petroleum which will not ignite at a tem- § 4472, R. S.  
perature of less than 110° Fahrenheit may, upon routes  
where there is no other practicable mode of transporting  
it, be carried on passenger steamers; but it shall not be  
lawful to receive on board or transport any petroleum  
unless the owner or master of the steamer shall have first  
received from the inspectors a permit designating the  
place or places on such steamer in which the same may be  
carried or stowed, with the further condition that the  
permit shall be conspicuously posted on the steamer.

7. Refined petroleum must not in any case be received § 4472, R. S.  
on board or carried unless it is put up in good iron-bound  
casks or barrels or in good metallic cans or vessels, care-  
fully packed in boxes, and the casks, barrels, or boxes  
plainly marked on the heads thereof with the shipper's  
name, the name of the article, and the degree or tempera-  
ture (Fahrenheit) at which the petroleum will ignite.

Moter vehicles or automobiles having attached tanks  
containing gasoline or any of the products of petroleum,  
transported on steamers carrying passengers, under the  
provisions of section 4472, Revised Statutes, must be

(X, 7)

carried on the open deck of such steamers, and located where they can be instantly reached in case of fire.

§ 4477, R. S.

8. All steamers navigating the ocean during the nighttime shall have a lookout at or near the bow and one watchman in each cabin and steerage.

§ 4477, R. S.

9. All passenger steamers navigating rivers, lakes, bays, and sounds in the nighttime shall have a watchman on each deck below the hurricane deck, including the cabins, such as are accessible to the passengers and crew when under way; and a lookout at the bow, excepting on steamboats navigating the waters emptying into the Gulf of Mexico having hurricane decks that terminate abaft the stem. Then the lookout shall be stationed on the forward part of such hurricane deck, who shall perform no other duty between sunset and sunrise.

§ 4405, R. S.

10. *Starting, stopping, and backing signals for steam vessels navigating the waters of the eighth and ninth supervising inspection districts.*

The eighth district embraces all the waters of the Great Lakes north and west of Lake Erie with their tributaries.

The ninth district embraces all the waters of the River St. Lawrence, Lakes Erie, Ontario, Champlain, and their tributaries.

There shall be used between the master or pilot and engineer the following code of signals, to be made by bell or whistle, namely:

1 whistle or 1 bell.....	Go ahead.
1 whistle or 1 bell.....	Stop.
2 whistles or 2 bells.....	Back.
3 whistles or 3 bells.....	Check.
4 whistles or 4 bells.....	Strong.
4 whistles or 4 bells.....	All right.

Two whistles or two bells shall always mean back, irrespective of other signals previously given.

The signals between the pilot house and engine room on Alaskan rivers shall be as follows:

When at rest, 1 jingle.....	Stand by.
1 stroke of gong.....	Ahead full speed.
2 strokes of gong.....	Astern full speed.
1 stroke of gong.....	Stop when going ahead or astern.
1 stroke of gong and 1 jingle.....	Ahead half speed.
2 strokes of gong and 1 jingle.....	Astern half speed.
When going astern or ahead half speed, 1 jingle.....	Full speed.
When going astern or ahead full speed, 1 jingle.....	Half speed.
When going ahead or astern, any speed, 2 jingles.....	Very slow.

§ 4405, R. S.

11. Any master or pilot of any steam vessel who shall flash or caused to be flashed the rays of the searchlight into the pilot house of a passing vessel shall be deemed guilty of misconduct and shall be liable to have his license suspended or revoked.

12. The efficient fog bell required upon vessels by law shall be held to mean a bell not less than 8 inches in diameter from outside to outside, and constructed of bronze or brass or other material equal thereto in tone and volume of sound. (X, 12)  
§ 4405, R. S.

13. Unnecessary sounding of the steam whistle is prohibited within any harbor limits of the United States. Whenever any licensed officer in charge of any steamer authorizes or permits such unnecessary whistling, upon conviction thereof before any board of inspectors having jurisdiction such officer shall be suspended from acting under his license as the inspectors trying the case may deem proper. § 4405, R. S.

14. Any master or pilot of any steam vessel who shall authorize or permit the carrying of any light, electric or otherwise, not required by law, on the outside structure of the cabin or hull of the vessel that in any way will interfere with distinguishing the signal lights shall, upon conviction thereof before any board of inspectors having jurisdiction, be deemed guilty of misconduct and shall be liable to have his license suspended or revoked. §§ 4405, 4450, R. S.

15. Suction pipes for all pumps on steam vessels shall be so arranged as to have an area of opening sufficiently large to supply water when pumps are working at full full capacity. § 4471, R. S.

#### **RULES OF PRACTICE FOR THE GOVERNMENT OF SUPERVISING AND LOCAL INSPECTORS OF STEAM VESSELS IN TRIALS OF LICENSED OFFICERS OF VESSELS.**

##### **I. APPLICATION AND ISSUE OF LICENSES.**

1. Application for original license shall be made on the prescribed forms, and comply with the requirements of law. §§ 4439, 4440, 4441, 4442, R. S.

2. Inspectors will furnish applicants with a written or printed notice of the time and place of examination.

3. If the inspectors shall decline to grant the applicant the license asked for they shall furnish him a statement, in writing, setting forth the cause of their refusal to grant the same.

##### **II. SUSPENSION AND REVOCATION OF LICENSES.**

1. The inspectors shall, when charges have been duly filed against a licensed officer of vessel, furnish the accused with a copy thereof, setting forth specifically their character and the section of the statutes or the rules of the board that have been violated. §§ 4448, 4449, 4450, R. S.

2. Subpoenas shall be in the prescribed form, one copy of which shall be furnished each witness.

3. All testimony shall be reduced to writing. The accused shall be permitted to cross-examine witnesses, and in case of exceptions to questions for any cause the inspectors shall note the exceptions in the margin of the deposition. The deposition shall be signed by the wit-

(II, 3) ness and sworn to before an officer authorized to administer oaths.

4. The accused may have the hearing of the case continued upon the presentation of reasons satisfactory to the board, and the board may, in like manner, continue the hearing from day to day.

5. During the trial the witnesses shall be examined separately, but if the accused is also a witness he shall not be subject to this rule.

6. At any time before the conclusion of the evidence the charge or charges, if being tried on charges, may be amended, notice of said amendment being furnished to the accused of the nature of such amendment, but no amendment shall be permitted after the conclusion of the evidence.

7. Where the witnesses reside in a district other than that in which the accused is being tried, a certified copy of the charges, together with such interrogatories as the inspectors desire to propound, may be forwarded to the inspectors of the district where the witnesses reside, and said inspectors shall examine the witnesses in the same manner as prescribed in section 3 of this rule.

8. The testimony thus taken shall be forwarded to the inspectors investigating the case and read as evidence in the cause, the same as though such testimony had been taken by the inspectors trying the same.

9. The inspectors will furnish the accused with a statement in writing of their finding in the premises.

10. No copy of testimony or other matter obtained in any investigation held by any board of local inspectors shall be given out, but a copy of testimony taken at a trial by any board of local inspectors shall be given to the accused or his representative when request for same is made.

### III. APPEAL TO SUPERVISING INSPECTORS.

§ 4452, R. S.

1. The supervising inspector, upon notice of an appeal from the decision of the local board, provided said notice of appeal shall be made within thirty days from the date of the decision of the local board, shall give notice in writing to said local board to forward a certified copy of their decision, together with the charges and all evidence in writing on file in their office.

2. The supervising inspector shall then proceed to investigate the case under the same rules prescribed for the trial of the accused by the local board.

3. The testimony taken before the local board may be considered by the supervising inspector for the purpose of determining whether the finding of the local board is justified by the evidence, and he shall have power to remand the same for explanation or correction.

4. Upon the conclusion of the case the supervising inspector shall furnish the appellant with a notice of his finding in like manner as prescribed for local inspectors.

## APPENDIX.

The following formulas, equivalent to those of the British Board of Trade, are given for the determination of the pitch, distance between rows of rivets, diagonal pitch, maximum pitch, and distance from centers of rivets to edge of lap of single and double riveted lap joints, for both iron and steel boilers:

Let  $p$  = greatest pitch of rivets in inches.

$n$  = number of rivets in one pitch.

$p_d$  = diagonal pitch in inches.

$d$  = diameter of rivets in inches.

$T$  = thickness of plate in inches.

$V$  = distance between rows of rivets in inches.

$E$  = distance from edge of plate to center of rivet in inches.

### TO DETERMINE THE PITCH.

*Iron plates and iron rivets:*

$$p = \frac{d^2 \times .7854 \times n}{T} + d.$$

Example, first, for single-riveted joint: Given, thickness of plate ( $T$ ) =  $\frac{1}{2}$  inch, diameter of rivet ( $d$ ) =  $\frac{7}{8}$  inch. In this case  $n = 1$ . Required the pitch.

Substituting in formula, and performing operation indicated,

$$\text{Pitch} = \frac{(\frac{7}{8})^2 \times .7854 \times 1}{\frac{1}{2}} + \frac{7}{8} = 2.077 \text{ inches.}$$

Example for double-riveted joint: Given,  $t = \frac{1}{2}$  inch and  $d = \frac{13}{16}$  inch. In this case  $n = 2$ . Then—

$$\text{Pitch} = \frac{(\frac{13}{16})^2 \times .7854 \times 2}{\frac{1}{2}} + \frac{13}{16} = 2.886 \text{ inches.}$$

For *steel* plates and steel rivets:

$$p = \frac{23 \times d^2 \times .7854 \times n}{28 \times T} + d.$$

Example for single-riveted joint: Given, thickness of plate =  $\frac{1}{2}$  inch, diameter of rivet =  $\frac{15}{16}$  inch. In this case  $n = 1$ .

$$\text{Pitch} = \frac{23 \times (\frac{15}{16})^2 \times .7854 \times 1}{28 \times \frac{1}{2}} + \frac{15}{16} = 2.071 \text{ inches.}$$



Example for double-riveted joint: Given, thickness of plate =  $\frac{1}{2}$  inch, diameter of rivet =  $\frac{7}{8}$  inch.  $n = 2$ . Then—

$$\text{Pitch} = \frac{23 \times (\frac{7}{8})^2 \times .7854 \times 2}{28 \times \frac{1}{2}} + \frac{7}{8} = 2.85 \text{ inches.}$$

FOR DISTANCE FROM CENTER OF RIVET TO EDGE OF LAP.

$$E = \frac{3 \times d}{2}.$$

Example: Given, diameter of rivet ( $d$ ) =  $\frac{7}{8}$  inch; required the distance from center of rivet to edge of plate.

$$E = \frac{3 \times \frac{7}{8}}{2} = 1.312 \text{ inches, for single or double riveted lap joint.}$$

FOR DISTANCE BETWEEN ROWS OF RIVETS.

The distance between lines of centers of rows of rivets for double, chain-riveted joints ( $V$ ) should not be less than twice the diameter of rivet, but it is more desirable that  $V$  should not be less than  $\frac{4d+1}{2}$ .

Example under latter formula: Given, diameter of rivet =  $\frac{7}{8}$  inch; then—

$$V = \frac{(4 \times \frac{7}{8}) + 1}{2} = 2.25 \text{ inches.}$$

For ordinary, double, zigzag riveted joints:

$$V = \frac{\sqrt{(11p+4d)(p+4d)}}{10}.$$

Example: Given, pitch = 2.85 inches, and diameter of rivet =  $\frac{7}{8}$  inch; then—

$$V = \frac{\sqrt{(11 \times 2.85 + 4 \times \frac{7}{8})(2.85 + 4 \times \frac{7}{8})}}{10} = 1.487 \text{ inches.}$$

DIAGONAL PITCH.

For double, zigzag riveted lap joint. Iron and steel:

$$p_d = \frac{6p+4d}{10}.$$

Example: Given, pitch = 2.85 inches, and  $d = \frac{7}{8}$  inch; then—

$$p_d = \frac{(6 \times 2.85) + (4 \times \frac{7}{8})}{10} = 2.06 \text{ inches.}$$

## MAXIMUM PITCHES FOR RIVETED LAP JOINTS.

For single-riveted lap joints:

$$\text{Maximum pitch} = (1.31 \times T) + 1\frac{1}{8}.$$

For double-riveted lap joints:

$$\text{Maximum pitch} = (2.62 \times T) + 1\frac{1}{8}.$$

**Example:** Given, a thickness of plate =  $\frac{1}{2}$  inch, required the maximum pitch allowable.

For single-riveted lap joint:

$$\text{Maximum pitch} = (1.31 \times \frac{1}{2}) + 1\frac{1}{8} = 2.28 \text{ inches.}$$

For double-riveted lap joint:

$$\text{Maximum pitch} = (2.62 \times \frac{1}{2}) + 1\frac{1}{8} = 2.935 \text{ inches.}$$

To determine the pitch of rivets from the above formulas, use the diameter and area of the rivet holes. The diameter of the rivets is the diameter of the driven rivet.

Any riveted joint will be allowed when it is constructed so as to give an equal percentage of strength to that obtained by the use of the formula given.

## **RULES OF ORDER.**

[Adopted at the special meeting held June, 1871; amended January 29, 1885.]

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I. The president shall take the chair at the hour appointed, a quorum being present, and shall call the board to order, when the secretary shall read the proceedings of the preceding day, which, if correct, shall be approved, and the following order of business be observed:

First. Presentation of communications by districts.

Second. Motions and resolutions.

Third. Presentation of memorials and petitions.

Fourth. Reports of committees of the board.

Fifth. Miscellaneous business.

II. The president shall preserve decorum and order; he shall pronounce the decision of the board on all subjects, and shall decide all questions of order without debate, unless, entertaining doubts on the point of order raised, he may call for the sense of the board; he may speak on points of order only, rising from his seat; he may also on any other occasion call any member to the chair, and while on the floor he shall have the privilege of entering into any debate on any question before the board; such substitution, however, shall not extend beyond an adjournment. An appeal may be made from the decision of the president by any two members, on which no member shall speak more than once without leave of the board.

III. Any member who shall deliver his opinion or speak in any debate shall rise in his place and respectfully address the president, and shall confine himself to the question under debate, and avoid personality. If two or more members rise to speak at the same time, the president shall decide who shall speak first.

IV. No member shall speak more than twice on the same question without leave of the board; nor more than once until every member choosing to do so shall have spoken.

V. If a member, while speaking, is called to order by the president or by any other member, he shall cease speaking until it is determined whether he is in order or not, and the objectionable words shall, if required, be reduced to writing.

VI. No motion shall be debated or open for discussion or decision until the same has been seconded, and it shall be reduced to writing if desired by the president or any member.

VII. When a question is before the board no motion shall be received but to adjourn, to lay on the table, to postpone indefinitely, to postpone to a certain day, to commit, to amend; which several motions shall have precedence in the order they here stand arranged.

VIII. A motion to adjourn shall always be in order, and shall be decided without debate. When a question is postponed indefinitely, the same shall not be acted upon again or reconsidered during the session of the board.

IX. When the yeas and nays shall be called on any question, which may be done when three members require it, the secretary shall call the names of the members by districts, commencing with the first, when the members present shall answer affirmatively or negatively as their names are called, unless they shall be excused by the board: *Provided, however,* That the yeas and nays shall always be called upon the adoption of a rule or device requiring the approval of the Secretary of Commerce and Labor. The absentees and those not voting shall also be recorded.

X. Any member may call for the division of a question when the sense will admit of it.

XI. When a blank is to be filled, and different sums, numbers, or times shall be proposed, the question shall first be taken on the highest sum or number and on the longest or latest time.

XII. When the reading of any paper or other matter is called for, and the same is objected to by any member, it shall be determined by a vote of the board.

XIII. Every member of the board present shall vote on all questions unless excused by the board and all questions shall be decided by a majority of votes, except in cases otherwise provided.

XIV. No motion for reconsideration shall be received unless made by a member and seconded by another who voted in the majority on the question.

XV. All committees shall be appointed by the president unless otherwise ordered by the board on motion, in which case they may be appointed by ballot or *viva voce*.

XVI. Before putting the question the president shall ask: "Is the board ready for the question?" If no member rise to speak, and a majority of the board are ready for the question, the president shall put the question; and after doing so, no member shall speak upon it.

XVII. If a pending question be lost by adjournment of the board and revived on the succeeding day, no member who shall have spoken upon it twice on the preceding day shall be permitted again to speak on it without leave.

XVIII. When a motion is made to lay on the table, the question shall be taken without debate.

XIX. Any one or more of the foregoing standing rules may be altered or amended when a majority of the board shall so determine, provided a motion to alter, amend, or change shall have been at least one day before the board.

XX. All cases of order not herein provided for shall be governed, in the discretion of the board, by the best uses in like cases, particularly such as prevail in the Congress of the United States.

XXI. The board shall, at every session, elect one of its members as secretary.

# **INSTRUMENTS, MACHINES, AND EQUIPMENTS APPROVED FOR USE ON STEAM VESSELS.**

[Year in which approved is given in parenthesis.]

## **LIFEBOATS.**

- Aniello lifeboat. (1895.)
- P. R. Beaupré, Metropolis, Ill., automatic self-righting and bailing lifeboat. (1872.)
- Burke, Wise & Co.'s lifeboat lowering and launching apparatus. (1878.)
- Baswitz lifeboat. (1897.)
- Berthon collapsible lifeboat. (1897.)
- Dickinson's self-righting lifeboat. (1881.)
- Dean & Co.'s improved diagonal lifeboat. (1883.)
- Dobbin's lifeboat. (1885.)
- Dobbin's metallic lifeboat. (1888.)
- Thomas Drein & Sons, Wilmington, Del., corrugated metallic lifeboat, when fitted with suitable bottom boards of usual form to prevent the bulging of the floor plates by falling timbers. (1900.)
- J. Walter Douglas, lifeboat. (1893.)
- Eddy's patent sea lifeboat. (1883.)
- Englehardt collapsible (folding) lifeboat, The Englehardt Collapsible Lifeboat Co., Long Island City, N. Y. (1904.)
- George Judson's lifeboat. (1878.)
- International Automatic Lifeboat Co., Chicago, Ill., and Portland, Me. Metallic lifeboat. (1911.)
- O. R. Ingersoll, self-righting and self-bailing lifeboat. (1887.)
- Mayo Rescue lifeboat, R. D. Mayo, Muskegon, Mich. (1901.)
- Mayo Junior lifeboat, Robert D. Mayo, jr., Hopkins Station, Mich. (1904.)
- F. L. Norton's lifeboat; boats to be built of yellow metal. (1887.)
- W. J. Nunan's lifeboat. (1897.)
- Richardson's self-righting and self-bailing lifeboat. (1884.)
- Mr. Stoddars's self-righting and self-bailing lifeboat. (1872.)
- Shear's self-bailing and self-righting boat. (1873.)
- William H. Taylor's lifeboat. (1894.)
- Loring W. Myers's lifeboat. (1905.)

## **LIFEBOAT DISENGAGING APPARATUS.**

- Boat automatic releasing device, presented by Bouchard & Killian, Milwaukee, Wis. (1909.)
- Coston boat-releasing gear, Coston Signal Co., Inc., New York N. Y. (1911.)
- Duinkers boat-releasing device, Royal Dutch West-India Mail, New York, N. Y. (1909.)
- Gaertner boat-releasing hook, R. A. Gaertner, Seattle, Wash. (1911.)
- Hunt automatic boat-releasing device, Charles Hunt, New York, N. Y. (1909.)
- J. J. Haviside, jr., San Francisco, Cal. Boat-releasing hook. (1911.)

## Interisland.

- Honolulu, Ha. engaging boat hook, presented by Capt. A. Tullett, Mills patent, approved for use only in Hawaiian waters. (1909.)  
 Co., Ltd., Sunderland, disengaging gear, presented by William Mills Murray boat-disengaging gear, presented by William Mills N. Y. (1909.)  
 New England Navigation apparatus, A. Luckhurst, New York, (1906.)  
 Co.'s standard boat-disengaging gear.  
 Raymond boat-releasing apparatus, presented by James R. Raymond, New York, N. Y. (1906.)  
 Boat-detaching device, presented by Henry E. Rottmer, Washington, D. C., approved only when installed with the lever fitted so as to be conveniently operated by the officer at the boat. (1906.)  
 Randle patent boat-disengaging apparatus, presented by the New York Shipbuilding Co., Camden, N. J. (1906.)  
 Semple & Ward boat-disengaging apparatus, presented by Capt. Allen Luckhurst, International Navigation Co., New York, N. Y. (1907.)  
 Boat-detaching hook, presented by Chas. E. W. Young, Norfolk, Va. (1909.)  
 Young's lifeboat releasing device, presented by Young Bros., Buffalo, N. Y. (1909.)

## WHISTLES FOR MOTOR VESSELS.

- Electro-corno whistle, presented by The Elkhart Dry Battery and Signal Co., Elkhart, Ind. (1910.)  
 Ever Ready electric horn, for use on motor boats, the American Ever Ready Co., New York, N. Y. (1911.)  
 Holtzer-Cabot electric horn, the Holtzer-Cabot Electric Co., Brookline, Mass. (1909.)  
 Jones electric horn, presented by Joseph W. Jones, New York, N. Y. (1910.) Any other like device equally efficient is allowed for use.  
 Klaxon warning signals, electric and hand actuated, for use on motor vessels, presented by Miller R. Hutchinson, New York, N. Y. (1909.) Any other device equally efficient also allowed for use.  
 Mesco electric horn, presented by the Manhattan Electrical Supply Co., New York, N. Y. (1911.)  
 Sireno warning signal, presented by The Sireno Co., New York, N. Y. (1911.)

## LIFE RAFTS.

- American Flexible Life Raft Co. (1877.)  
 Ammen metallic balsa or life raft. (1895.)  
 Anderson and Bailey, San Francisco, Cal. (1910.)  
 M. A. Bryson's deer-hair life raft. (1877.)  
 Beasley's life raft. (1881.)  
 Hon. H. C. Calkin's, New York, metallic raft. (1872.)  
 Clark's life raft. (1873, 1910.)

- J. A. Cone. (1875.)  
 J. A. Cone's life raft (Drein & Son), Wilmington, Del. (1886.)  
 Columbia life raft, Churchman & Groves, Philadelphia, Pa. (1886.)  
 Chamber's life raft. (1888.)  
 Carley life float, Carley Life Float Co., M. T. Whiton, president. (1901.)  
 Davis's life raft. (1877.)  
 Frazee Life Raft Co., New York, metallic raft. (1872.)  
 Griffith life raft. (1890.)  
 Edwin A. Hay's life raft. (1883.)  
 Emmett Harding's combined life raft and settee, when cylinders are constructed of metal. (1884.)  
 Hussey life raft. (1894.)  
 O. R. Ingersoll, New York, metallic raft. (1872.)  
 O. R. Ingersoll's life raft, canvas cylinders covered with rattan, when provided with cross braces and air-tight valves for determining its air-tight condition. (1884.)  
 O. R. Ingersoll's life raft composed of two cylinders made of cane and filled with block cork. (1887.)  
 David Kahnweiler's metallic life raft. (1888.)  
 Le Duc Tye Improvement Co.'s life raft, San Francisco, Cal., (1886.)  
 Lane and De Groot, Brooklyn, N. Y., metallic life raft. (1898.)  
 Matson life raft, H. J. Matson, Boston, Mass. (1909.)  
 Miller's life-saving raft. (1881.)  
 Moran Bros. Co., Seattle, Wash., metallic life raft. (1906.)  
 Ogden's life raft. (1874.)  
 Rider's life raft. (1877.)  
 Robert Roberts's metallic raft. (1884.)  
 Lewis H. Raymond's life raft. (1881.)  
 L. H. Raymond, the Reliance metallic life raft. (1896.)  
 W. S. Ray Manufacturing Co., San Francisco, Cal., metallic life raft. (1906.)  
 John T. Smith's metallic life raft, when the cylinders are provided with water-tight bulkheads placed not over 2 feet apart. (1884.)  
 John T. Smith's life raft, when constructed of galvanized iron of not less than 24 wire gauge, Birmingham standard, in thickness. (1885.)  
 Torrey & Co. (1872.)  
 Woolsey's life buoy. Rated for two persons, for lake, bay, and river, when made, as at present, of 52 pounds of cork, and in that proportion when containing a greater amount of cork. (1881-1883.)  
 F. H. Ward's metallic folding life raft. (1897.)  
 Welin Davit and Lane and De Groot Co., New York, N. Y. Metallic life raft. (1911.)

#### LIFE PRESERVERS.

- Armstrong Bros. & Co., compressed granulated cork life preserver. (1885.)  
 A B C life belt, presented by the Lane & De Groot Co., New York, N. Y. (1909.)  
 Absolute Fireproofing Co. (Inc.), New York, N. Y. Life preserver made of butts flags. (1911.)

- Bryson's deer-hair life preserver. (1877.)  
 H. Brunswig, life-saving buoy. (1898.)  
 Butz block-cork life preserver. (1905.)  
 E. Clark, cork life preserver. (1872.)  
 George Clark, jr., life preserver. (1878.)  
 Eliza R. Cogswell, life preserver invented by. (1883.)  
 James S. Dunant's California tule life preserver, when ends of tule  
 are bound with copper wire. (1884.)  
 Godfrey & Boyce's life preserver. (1875.)  
 J. B. Hamilton's life preserver, Springfield, Mass. (1901.)  
 Dr. Charles Hunt's life preserver, New York, N. Y. (1907.)  
 O. R. Ingersoll, cork life preserver. (1872.)  
 Kahnweiler's never-sink life preserver. (1874.)  
 D. Kahnweiler & Son's pressed-cork life preserver. (1894.)  
 Le Duc Tule Improvement Co.'s life preserver, when ends of tule  
 are bound with copper wire. (1886.)  
 C. M. Lane of the Lane & De Groot Co., Long Island City, N. Y.,  
 the Ravenswood life preserver. (1904.)  
 C. S. Merriman, rubber life-saving dress. (1877.)  
 Joseph K. McCammon, the Le Duc. (1887.)  
 Morrison Life Belt Co., St. Louis, Mo., cork life preserver. (1904.)  
 National Cork Co., life preserver. (1904.)  
 Fitch Reynolds's cork life preserver. (1879.)  
 J. A. Seamans, cork life preserver. (1872.)  
 M. A. Scott, cork life preserver. (1872.)  
 John T. Smith's life preserver, New York. (1892.)  
 The Edward Maynard life preserver, presented by John T. Smith,  
 New York. (1887.)  
 United Indurated Fibre Co., Lockport, N. Y. (1908.)  
 Upson-Walton Co., solid cork life preservers. (1905.)  
 White & Hay's cork life jacket. (1878.)

#### LINE-CARRYING GUNS AND PROJECTILES.

- Cunningham self-line-carrying rocket. (1890.)  
 Cunningham small rocket for vessels of 500 tons and over 100 tons.  
 (October 9, 1891.)  
 Hunt's line-carrying gun, large. (1890.)  
 Hunt's line-carrying gun, small. May be used on all vessels from  
 100 to 500 tons. (1890.)  
 Hunt gun, No. 2, 20 inches long, 2½ inches diameter of bore. May  
 be used on steam vessels from 100 to 500 tons when the gun is con-  
 structed in all its parts of material same as used in the large Hunt  
 gun already approved by this board. (1893.)  
 International line-carrying gun No. 3, George Murch, New York,  
 N. Y. (1909.)  
 Lyle line-carrying gun. (1890.)  
 Lyle life-saving shoulder gun may be used on all vessels not exceed-  
 ing 300 gross tons. (1906.)  
 Gun and self-anchoring projectile carrying a life line, presented by  
 Meyer & Rogers, Seattle, Wash. (1907.)  
 Meyer-Rogers line-carrying gun No. 2, Meyer-Rogers Projectile Co.,  
 New York, N. Y. (1909.)



Equipment for the Meyer-Rogers line-carrying guns Nos. 1 and 2, Meyer-Rogers Projectile Co., New York, N. Y. (1909.)

Sample line shot tracer, presented by John B. Semple, Pittsburg, Pa. (1907.)

United States Life-Saving Equipment Co., Boston, Mass. Illuminated double line-carrying shot. (1911.)

#### FIRE EXTINGUISHERS.

Liquid chemical fire extinguishers approved for use on steamers carrying passengers, when liquid is contained in copper cylinders tested and guaranteed to withstand a pressure of at least 350 pounds to the square inch.

Accurate (1905), Acme (1905), Alert<sup>1</sup> (1909), Arctic (1909), Babcock No. 1<sup>1</sup> (6 gallons, 1905), Badger (1905), Boyd Marine (1905), Bradford (1908), Bonner<sup>1</sup> (6 gallons, 1910), No. 5 Bonner (5 gallons, 1911), Pony Bonner (1911), Childs<sup>1</sup> (1905), Columbia (1905), Competitor (1905), Crescent (1906), Conqueror (1909), Coston<sup>1</sup> (1911), Diggs Automatic (1905), Diggs Upright (1905), Durkee<sup>1</sup> (1911), Ecnarusni (1905), Ever Ready (tank made of seamless steel, tested to 600 pounds to square inch, 1907), Ever Ready<sup>1</sup> (18 gallons, 1911), Eastman (1907), Gold Medal No. 1<sup>1</sup> (1911), Handley's Cageless (1905), Holloway (1905), Hayward<sup>1</sup> (1910), Improved Standard (1905), Insurance (1905), International (1905), Johnston (1908), Keystone<sup>1</sup> (1905), Ko-Jen-Si auxiliary fire appliance (1908), Kanawha (1909), La Prudencia (3 gallons, 1911), Marine Rex (1905), Metropolitan (1905), Metropolitan No. 2 (1905), Minimax (1905; 1½-gallon machine, rated at 2½ gallons, 1907), Monarch (1906), National Standard (1905), National (1906), New York (1907), Patrol (1905), Phoenix (1905), Protector<sup>1</sup> (1908), Pyrene<sup>1</sup> (1908), Perfect (size 3, seamless steel, 1910), Premier (1910), Paragon<sup>1</sup> (3 gallons, 1911), Quick Action (1905), Queen (1907), Railway and Marine (1905), Regina (1905), Rex (1905), Royal<sup>1</sup> (1905), Rescue (1910), Salvage<sup>1</sup> (1905), Standard (1905), Stempel<sup>1</sup> (1905), Seagrave Model (1908), Sieben chemical fire-extinguishing hose nozzle (1908), Safety<sup>1</sup> (1910), Success<sup>1</sup> (3 gallons, 1910), B Safe Guard (3 gallons, 1911), No. 4 Traveler (one of not less than 2½ gallons or two of 7-quart size may be used, 1911), Underwriters (1905), Underwriters No. 6<sup>1</sup> (1911), United States (1905), United States 2d style (1905), Utica No. 2 (without hose, 1905), Utica No. 3 (without hose, 1905), Utica No. 7 (with stopcock and without hose, 1906), Utica No. 8 (with stopcock and without hose, 1906), Universal (1907), Victor (1905), and Yost (1908).

Little Giant (of the pump type and 3-gallon capacity, 1905).

McLaughlin chemical fire pail, hermetically sealed, of 3 gallons each; 2 allowed for use in lieu of one 2½-gallon chemical fire extinguisher and 4 in lieu of 12 ordinary water pails. (1909.)

Fire extinguishers approved for use, but not allowed as substitute for the fire extinguishers required by section 13, Rule IV:

American (1905), Excelsior (1905), Ever Ready Standpipe System (1907), Eclipse (dry dust, 1909), Fyricide (1905), Motor Rex (1905), Nevermyss (without hose, 1905).

<sup>1</sup>Has demonstrated before the Board of Supervising Inspectors a capacity for extinguishing burning gasoline.

## TANKS.

American fire-bucket tank containing 25 gallons of chemical liquid, and 6 10-quart buckets. (1909.)

Safety fire-bucket tank, No. 1 containing 6 10-quart buckets, and No. 2 containing 6 14-quart buckets, with chemical preparation. (1910.)

## APPARATUS FOR EXTINGUISHMENT OF FIRE IN COMPARTMENTS OF STEAMERS.

Clayton fire-extinguishing system. (1905.)

Grinnell automatic sprinkler. (1909.)

## STEAM PUMPS.

Coll's single-suction steam siphon, presented by Mr. Coll, Pittsburg, Pa. (1872.)

Coll's improved steam siphon pump. (1874.)

Hall's duplex steam pump. (1889.)

Landsell's double-suction steam siphon, presented by H. S. Landsell, New York. (1872.)

A. Sluthouer, New Philadelphia, Ohio, fire and bilge pump. (1872.)

Sheriff's steam siphon pump. (1875.)

Van Duzen & Tift's steam jet pump, for use as a steam fire pump on steamers of 100 tons and under (1884.)

## SAFETY VALVES.

Common lever valve. (1884.)

H. G. Ashton, East Cambridge, Mass. (1872.)

Ashcroft's safety valve. (1877.)

American Steam Gauge Co., Boston, Mass.; American spring safety valve. (1885.)

Adams spring safety valve, manufactured by Thomas Adams & Co., Manchester, England; presented by Luther D. Lovekin, Camden, N. J. (1903.)

Case & Bailey, Detroit, Mich. (1872.)

Cockburn's safety valve. (1877.)

Crosby's safety valve. (1877.)

George E. Collyer, safety valve. (1883.)

Consolidated Safety Valve Co., New York, N. Y.; pop safety valves (Richardson & Co., Troy, N. Y., 1872.)

Crosby & Meady, pop safety valve. (1888.)

J. M. Coale's pop safety valve and muffler. (1894.)

Crane pop safety valve, presented by the Crane Co. (1895.)

Dry Dock Engine Works, Detroit, Mich. (1873.)

Spring-loaded safety valve, presented by James W. Elwell & Co., New York, N. Y., manufactured by Lethuillier & Pinel, Rouen, France. (1904.)

Hodgin's safety valve. (1877.)

Herreshoff Manufacturing Co., pop safety valve. (1883.)

Hall's incased safety valve, when lever is permanently attached to valve casing. (1889.)

Norman L. Hayden, Columbus, Ohio, Tippet spring safety valve. (1903.)

The N. L. Hayden Manufacturing Co., Columbus, Ohio, Hercules spring-loaded safety valve. (1904.)

E. B. Kunkle, spring-loaded safety valve. (1886.)

I. T. Kearns, pop safety valve. (1893.)

J. D. Lynde, Philadelphia, Pa. (1872.)

F. Lunkenheimer, safety valve. (1888.)

The Lunkenheimer improved pop safety valve. (1896.)

Lynde safety valve, J. E. Lonergan Co., Philadelphia, Pa. (1910.)

Morse's safety valve. (1877.)

A. Orme's safety valve. (1877.)

W. E. Pierson, pop valve. (1883.)

R. F. Silliman's safety valve. (1884.)

Roe Stephens Manufacturing Co., Detroit, Mich., spring safety valve. (1892.)

Star Brass Manufacturing Co., pop safety valve. (1898.)

H. G. Trout, King Iron Works, Buffalo, N. Y., spring-loaded safety valve, and allowed a rating of 2 square feet of grate surface of boiler to 1 square inch area of valve to June 1, 1904. (1885.)

Utica pop safety valve, presented by the Utica Steam Gauge Co., of Frankfort, N. Y. (1900.)

#### PIPE BOILERS.

[Boilers and steam generators not constructed of riveted iron or steel plates, approved under section 4429, Revised Statutes.]

F. D. Althouse, New York, N. Y. (1889.)

F. S. Allen, New York, N. Y. (1884.)

Almy Water Tube Boiler Co., Providence, R. I. (Types A, B, and C, 1890; types D and E, 1897; Z type, 1911.)

George W. Arrowsmith, Fort Niagara, N. Y. (1894.)

American Fire Engine Co., Cincinnati, Ohio. (1900.)

Authentic water-tube boiler, Bugbee & Laycock, Chicago, Ill. (1901.)

Acme boiler, Detroit Water Tube Boiler Co., Detroit, Mich. (1902.)

J. L. Anderson, Seattle, Wash. (1904.)

Aultman & Taylor Machinery Co., Mansfield, Ohio. Park water-tube boiler. (1905.)

A. Perry Blivin, Brooklyn, N. Y. (1885.)

George B. Brayton, Providence, R. I. (1885.)

The Belleville boiler, presented by Miers Coryell, of New York. (1887.)

Brigham & Markham, Hartford, Conn. (1889.)

Braggin's, Rochester Machine Tool Works, Rochester, N. Y. (1889.)

Bowdish, Skaneateles, N. Y. (1890.)

John E. F. Bartlett, Brooklyn, N. Y. (1891.)

Alfred Box & Co., Philadelphia, Pa. (1892.)

Ira Bradley, Malden, Mass. (1892.)

Augustus Bailey, Spuyten Duyvil, N. Y. (1893.)

George D. Bower, Trenton, N. J. (1893.)

Babcock & Wilcox, New York, N. Y. (1894; improved type, 1911; drum type, 1911.)

- L. Boyer's Sons, New York, N. Y. (1894, 1901.)  
 Buschmann & Layman, Baltimore, Md. (1895, 1897.)  
 John Bonner, Tiburon, Cal. (1895.)  
 C. R. Benton, Vergennes, Vt. (1896.)  
 Buckley patent water-tube pipe boiler, Rochester Machine Tool Works, Rochester, N. Y. (1896.)  
 Barr, Reynolds & Co., Rochester, N. Y.; E. P. Clapp boiler No. 1. (1897.)  
 George Bolland, Pittsburg, Pa. (1897.)  
 Bretherton boiler, James C. Wignall, Philadelphia, Pa. (1897.)  
 A. J. Beach, Moline, Ill. (1898.)  
 Joseph G. Brassard, Central Falls, R. I. (1898.)  
 Edward Bounds, Pittsburg, Pa. (1898.)  
 James H. Brown, Boston, Mass. (1898.)  
 Barr & Creelman, Rochester, N. Y. (1900.)  
 W. J. Boland, Chicago, Ill. (1900.)  
 Bugbee & Laycock, Chicago, Ill. Authentic water-tube boiler. (1901.)  
 Barton Boiler Co., Chicago, Ill.; Barton's flash boiler. (1904.)  
 Fred A. Ballin, Portland, Oreg. (1906; types Nos. 2 and 3, 1909.)  
 The Babcock & Wilcox Co., New York, N. Y.; White-Forster steam generator. (1909.)  
 B. F. Binnix, Washington, D. C. (1906.)  
 E. W. Bailey, Portsmouth, Va. (1907.)  
 Barnes pipe boiler, presented by Pierre Barnes, Seattle, Wash. (1909.)  
 John P. Badenhause, Seattle, Wash. (1911.)  
 C. H. Caswell, Newport, R. I. (1887.)  
 Miers Coryell, New York; the Belleville boiler. (1887.)  
 Copeland boiler, when composed in all its parts of wrought iron, copper, brass, or steel; Northrop Manufacturing Co. (1888.)  
 H. B. Cumming, Malden, Mass. (1889.)  
 C. B. Crowley & E. B. Browne, Brooklyn, N. Y. (1889.)  
 Clapp & Jones Manufacturing Co., Hudson, N. Y. (1889.)  
 Crawford & Saunier's, Newark, N. J. (Passaic, 1890; Gem, 1891.)  
 Cruikshank's, Providence, R. I. (1890.)  
 E. J. Copeland, New York, N. Y. (1891.)  
 Cary's steam generator changed from Gray's, Providence, R. I. (1891.)  
 Edward S. Clark, Boston, Mass. (1891, 1895, 1898.)  
 Clonbrock Steam Boiler Co., Brooklyn, N. Y. (1891, 1902.)  
 Clay & Torbensen, Camden, N. J. (1892.)  
 Cole & Reinhart, Camden, N. J. (1892.)  
 Louis S. Clark, Pittsburg, Pa. (1893.)  
 A. E. Corey, Allegheny, Pa. (1893.)  
 Collier Yacht & Engine Works, Detroit, Mich.; Collier sectional boiler. (1893, 1895.)  
 E. P. Clark, New York, N. Y. (1894.)  
 The Coulter & McKenzie Machine Co., Bridgeport, Conn. (1894.)  
 Christiansen marine boiler; John A. Duggan, Boston, Mass. (1894.)  
 C. R. Cowley, Brooklyn, N. Y. (1895.)  
 Baylies C. Clark, New York, N. Y. (1896.)  
 J. F. Craig, Toledo, Ohio; Craig water-tube boilers, Nos. 1 and 2. (1896.)

- E. P. Clapp boiler No. 1; Barr, Reynolds & Co., Rochester, N. Y. (1897.)
- William Cramp & Sons, Philadelphia, Pa.; Yarrow type No. 2, and Niclausse water-tube boiler. (1897.)
- W. T. Clark, Boston, Mass. (1897.)
- Osceola Currier, Newark, N. J. (1897.)
- E. P. Chancellor, Parkersburg, W. Va. (1898.)
- J. Castleman, Brooklyn, N. Y.; T. F. Morrin's pipe boiler. (1898.)
- James Carnegie, New York, N. Y.; Type B. (1899.)
- Peter Cone, Jacksonville, Fla. (1899.)
- Ed Cheetham, Detroit, Mich. (1900.)
- Chas. R. Cowley and Howell C. Cooper, Everett, Mass.; Cowley and Cooper boiler. (1901.)
- Charles D. Casad, Seattle, Wash. (1902.)
- C. B. Clark, South Brewer, Me. (1902.)
- B. F. Cook, Fort Pierce, Fla. (1902.)
- E. J. Codd, Baltimore, Md.; Smith patent boiler. (1904.)
- Will F. Cook, Oshkosh, Wis. (1906.)
- Fred Cline, Hoquiam, Wash. (1911.)
- E. G. Durant, for using petroleum. (1888.)
- L. D. Davis, Erie, Pa. (1891, 1894, 1898.)
- Anson C. Dearing, Detroit, Mich. (1894.)
- Charles De Vore, Philadelphia, Pa. (1894.)
- J. J. Driscoll, Stapleton, N. Y. (1894.)
- George E. Dow, Seattle, Wash. (1894.)
- John A. Duggan, Boston, Mass.; Christiansen marine boiler. (1894.)
- J. W. Dawson, Wyandotte, Mich. (1895.)
- E. N. Drouillard, Wyandotte, Mich.; Drouillard water-tube boiler No. 1. (1896.)
- Robert Don, Stockton, Cal. (1897.)
- Dearing water-tube boiler, Detroit, Mich. (1897.)
- Detroit Screw Works, Detroit, Mich.; Taylor boiler. (1898.)
- A. D. Davis, Yonkers, N. Y. (1899.)
- Detroit Water-Tube Boiler Co., Detroit, Mich. (1899.) The Acme boiler. (1902.)
- W. E. Dickey, New York, N. Y.; porcupine boiler. (1902.)
- C. F. Davenport, Brooklyn, N. Y., assigned to Empire State Engineering Co., New York, N. Y. (1904.)
- William F. Duval, Jersey City, N. J. (1904.)
- Dobler boiler attachment or water heater; presented by W. R. Miller, New York, N. Y. (1906.)
- F. W. Edwards, Bayonne, N. J. (1899.)
- Benjamin P. Emery, Kennebunkport, Me. (1899.)
- Henry Ernst, New York, N. Y. (1901.)
- A. C. Evans, Norfolk, Va. (1901.)
- Farnie & Geer, Syracuse, N. Y.; the Farnie boiler, steam pressure to be allowed on such boiler as the bracing will entitle the same to carry. (1887.)
- Hugo L. Frederick, copper boiler. (1889.)
- William Flaggs, Brooklyn, N. Y. (1891.)
- Charles W. Foster, New Haven, Conn. (1892, 1894, 1895.)
- W. S. Fairchild, Newark, N. J. (1892.)
- Walter B. Fowler, Lawrence, Mass. (1892.)
- H. H. Frederick, New Orleans, 3 horsepower. (1893.)

- Thomas Fearon, Yonkers, N. Y. (1893, 1895, 1897.)  
 Fenlayson & Popkins, Detroit, Mich. (1893.)  
 John A. Flajole, Bay City, Mich. (1894.)  
 William Flagg, Bayonne, N. J. (1895, 1898.)  
 H. E. Frauz, steam generator; presented by J. H. Mittendorff,  
 Washington, D. C. (1895.)  
 A. W. Finlayson, Detroit, Mich. (1896.)  
 Fore River Engine Co., Weymouth, Mass. (1897.)  
 Samuel M. Gray, Providence, R. I. (1890, 1896.)  
 Goodridge attachment for oil boilers. (1891.)  
 Gem boiler, Crawford & Saunier, Newark, N. J. (1891.)  
 J. M. Glover, Baldwin, Long Island, N. Y. (1892.)  
 James S. Gedeohn, Cleveland, Ohio; pipe boiler. (1892.)  
 Griswold pipe generator, Henry Suttor. (1893.)  
 E. U. Gibbs, Elmira, N. Y. (1894.)  
 C. F. Gallion, Baltimore, Md. (1895.)  
 T. W. Godwin & Co., Norfolk, Va. (1896.)  
 Gas Engine & Power Co. and Charles L. Seabury & Co., New  
 York, N. Y. (Types E, Alga, and Enterprise, 1898; Kanawha type,  
 1899; D improved and E improved, 1893.) See S—Charles L. Sea-  
 bury & Co.  
 Siren Galliher, Normal, Ky. (1898.)  
 F. G. Gibson, Dorchester, Mass. (1899.)  
 Thomas Gowen, Seattle, Wash. (1908.)  
 R. J. Galbraith, Albany, Oreg. (1911.)  
 Herreshoff, Bristol, R. I. (1873, 1878, 1898.)  
 S. P. Hedges, Greenport, N. Y. (1885, 1889, 1895.)  
 Hazelton Co., water-tube porcupine boiler. (1886.)  
 V. R. Hyde, Portland, Oreg.; the H. Statesmen boiler. (1886.)  
 The Hartley boiler; presented by the Pioneer Iron Works, Brook-  
 lyn, N. Y. (1887.)  
 Hohenstein, Newark, N. J. (1890.)  
 T. Hansen, Boston, Mass. (1891.)  
 E. Hayes, Rochester, N. Y. (1891.)  
 F. W. Hyslop, New York, N. Y. (1892.)  
 Gardener C. Hawkins, Boston, Mass. (1892.)  
 H. J. Hancock, New York, N. Y.; Howard steam generator. (1893.)  
 A. C. Harding, Chicago, Ill. (1893.)  
 Henry Haenel, St. Augustine, Fla. (1894.)  
 George H. Holmes, Gardiner, Me. (1894.)  
 Hampden Hyde, Rochester, N. Y. (1894.)  
 Heine safety boiler, by E. D. Meier, St. Louis, Mo. (1895.)  
 George Harden, Detroit, Mich. (1895.)  
 William H. Herbertson, Cadwallader, Pa. (1896.)  
 Henry A. House, Bridgeport, Conn. (1897.)  
 Henry E. Hull, Clinton, Conn. (1899.)  
 George L. Haman, Detroit, Mich. (1901.)  
 Gordon H. Hardie, Victoria, British Columbia. (1902.)  
 C. W. Hawkes, Chicago, Ill. (1906.)  
 Frank A. Hensley, San Antonio, Tex.; porcupine boiler. (1906.),  
 Hohenstein marine boiler; presented by Oil City Boiler Works,  
 New York, N. Y. (1907.)  
 International Power Co., Providence, R. I. (1900.)  
 Ernest A. John's boiler, New York, N. Y. (1892.)

- J. B. Jardine, San Francisco, Cal. (1894.)  
 J. R. Jackson, McKeesport, Pa. (1894.)  
 W. E. Jenkins and A. Stokey, Tacoma, Wash. (1900.)  
 Geo. E. Jones, Newark, N. J. (1900.)  
 Ernest N. Janson, Washington, D. C. (1901.)  
 Johnson Service Co., Milwaukee, Wis. (1907.)  
 John R. Karstendick, New Orleans, La. (1884.)  
 Charles L. Kraemer, New York, N. Y. (1898.)  
 J. H. King, Daytona, Fla. (1899. Modification, 1900, presented  
 by J. B. Sloan, Jacksonville, Fla.)  
 Chas. Kellogg, Athens, Pa. (1900.)  
 Geo. Krill & Bro., Baltimore, Md. (1900.)  
 Charles H. Kimball, Plattsburg, N. Y.; Kaelma boiler. (1902.)  
 C. W. Krotz, New Orleans, La. (1903.)  
 Keep & Co., Portland, Oreg. (1904.)  
 Lidback Manufacturing Co., Portland, Me. (1890.)  
 J. Lacroix and Ed Rey, New Orleans, La. (1892, 1898.)  
 Laughlen & Co., Pittsburg, Pa. (1893.)  
 John H. Lutz, Michigan City, Ind. (1894.)  
 J. H. & J. D. Lucas, St. Louis, Mo. (1895.)  
 L. W. Loomis, Carrollton, Ill. (1896.)  
 William H. C. Lyons, Philadelphia, Pa. (1896.)  
 Paul W. Lichtenberger, Philadelphia, Pa. (1897.)  
 Luippold Bros., Buffalo, N. Y. (1897.)  
 Geo. Lawley & Son Corporation, Boston, Mass. (1900.)  
 Harry Lawson, Jersey City, N. J. (1900.)  
 Joseph C. Lesley, St. Albans, Vt. (1900.)  
 S. C. Lighthill, Allegheny, Pa. (1900.)  
 W. S. Lowe, Lima, Ohio. (1900.)  
 L. A. Langmaid, Bath, Me. (1901.)  
 Harry Lawson, New York, N. Y. (1904.)  
 U. G. Lee, Chicago, Ill. (1904.)  
 Locomotive boiler; presented by the Locomobile Co. of America,  
 Chicago, Ill. (1904.)  
 Lyons Co. furnace boiler, Depere, Wis.; Bonson type. (1905.)  
 E. W. Millard, Troy, N. Y. (1889.)  
 C. B. Mosher, Amesbury, Mass. (1891.)  
 McQueen boiler; Sullivan & Ehler, Albany, N. Y. (1891.)  
 The Morrin Climax steam generator, Clonbrock Steam Boiler Co.,  
 Brooklyn, N. Y. (1891. Improved boiler, 1902.)  
 T. F. Morrin's pipe boiler; J. Castleman, Brooklyn, N. Y. (1898.)  
 T. F. Morrin, Brooklyn, N. Y.; horizontal and vertical types of  
 water-tube boiler. (1900.)  
 Frank Mahoney, New York, N. Y.; a horizontal boiler and a ver-  
 tical boiler. (1892.)  
 McBride Bros.' boiler, Philadelphia, Pa. (1892.)  
 C. McDonagh, Hancock, Mich. (1892.)  
 E. A. Magee, Brooklyn, N. Y. (1893.)  
 Joseph Mohr, Chicago, Ill. (1893.)  
 I. G. Morgan, Seattle, Wash. (1894.)  
 W. W. Moore, Eugene, Oreg. (1894.)  
 R. Munroe & Son, Pittsburg, Pa. (1894.)  
 E. D. Meier, St. Louis, Mo.; Heine safety boiler. (1895.)

- J. H. Mittendorff, Washington, D. C.; H. E. Frauz steam generator. (1895.)
- W. J. McCaffrey and Charles Hilbert, Sing Sing, N. Y. (1895.)
- John Mohr & Sons, Chicago, Ill. (1896.)
- August Miller, Jefferson Parish, La. (1897.)
- G. F. Martin, St. Joseph, Mich. (1897.)
- George F. Martin, Benton Harbor, Mich. (1898.)
- George H. Mallett, Westchester, N. Y. (1898.)
- J. W. McQueen, Detroit, Mich. (1899.)
- Edward J. Moore, Philadelphia, Pa. (1899.)
- Tug *Maytham*, Houghton, Mich.; copper firefurnace, special. (1899.)
- Walter MacFarlane, Seattle, Wash. (1900.)
- Marine Iron Works, Chicago, Ill. (1901.)
- Philip J. Miller, Annapolis, Md. (1903.)
- James McCartney, Mobile, Ala. (1904.)
- Charles D. Mosher, Mosher Water Tube Boiler Co., New York, N. Y., types A and B. (1904.)
- The W. D. McNaull water-tube boiler. Toledo, Ohio. (1905.)
- Miner flash steam generator, Winthrop Waite, New York, N. Y. (1907.)
- James J. Morris, Nashville, Tenn., flash boiler. (1910.)
- W. J. Montgomery, Detroit, Mich. (1911.)
- Northrop Manufacturing Co.; Copeland boiler, when composed in all its parts of wrought iron, copper, brass, or steel. (1888.)
- Niclausse water-tube boiler; William Cramp & Sons, Philadelphia, Pa. (1897.)
- New York Safety Steam Power Co., New York, N. Y.; the Worthington boiler. (1891, 1897.)
- New York Shipbuilding Co., Camden, N. J. (1902.)
- Nott Marine boiler, Nott Fire Engine Co., Minneapolis, Minn. (1906.)
- Harvey T. Nye, Toledo, Ohio. (1908.)
- Newport News Dry Dock and Shipbuilding Co., Newport News, Va. Type of Thornycroft boiler. (1910.)
- Ofeldt's, Newark, N. J. (1889.)
- Marvin E. Otis, Rochester, N. Y. (1891.)
- William Oldman, jr., Buffalo, N. Y.; horizontal and vertical boilers. (1896, 1897.)
- Charles Ogle and James Hall, Jeffersonville, Ind. (1897.)
- F. W. Ofeldt & Sons, Brooklyn, N. Y. (1901.)
- James E. Orme and Henry H. Orme, St. Paul, Minn. (1902.)
- Oil City Boiler Works, New York, N. Y.; Hohenstein marine boiler. (1907.)
- August Ofeldt, New York, N. Y.; circular pipe boiler and square pipe boiler. (1909.)
- Pioneer Iron Works, Brooklyn, N. Y.; the Hartley boiler. (1887.)
- Passaic boiler, Crawford & Saunier, Newark, N. J. (1890.)
- M. H. Plunkett, boiler, Nos. 1 and 2, Baltimore, Md. (1892.)
- Perkins & Richmond, Grand Rapids, Mich. (1894.)
- Frank Printz, New Orleans, La. (1895.)
- Charles S. Parker, Orange, Tex. (1895.)
- R. C. Price, Allegheny, Pa. (1895.)
- George E. & Charles A. Painter, Pittsburg, Pa. (1896.)
- William E. Plummer, jr., Buffalo, N. Y. (1896.)



- Joseph Provuncher, East Providence, R. I. (1896, 1898.)  
 D. A. Park, Brooklyn, N. Y. (1897.)  
 Dr. E. L. Parker, Detroit, Mich. (1898.)  
 J. E. Parker, Chicago, Ill. (1900.)  
 Archibald Pifer, Braidentown, Fla. (1900.)  
 Parker Boiler Co., Philadelphia, Pa. (1901.)  
 Thomas B. Perkins, Grand Rapids, Mich. (1901; improved porcupine boiler, 1903.)  
 S. T. Powers, New Orleans, La.; porcupine boiler. (1903.)  
 Pearson Manufacturing Co., Allegheny, Pa.; Pittsburgh boiler. (1904.)  
 Park water-tube boiler, by the Aultman & Taylor Machinery Co., Mansfield, Ohio. (1905.)  
 E. E. Roberts, New York. (1883.)  
 Rochester Machine Tool Works, Rochester, N. Y.; Braggins' boiler (1889, 1894); Buckley patent water-tube pipe boiler (1896.)  
 Martin R. Ruble, Newark, N. J. (1891.)  
 F. J. Robinson, Detroit, Mich. (1891.)  
 D. Rousseau, New York, N. Y. (1894.)  
 C. Reinhardt, Baltimore, Md. (1895.)  
 Roberts water-tube boiler, New York, N. Y. (1883); improvements in boiler (1895); types F, G, H, and I (1897.)  
 J. B. Rives, St. Paul, Minn.; Watrous boiler. (1896.)  
 Phil Rohan, St. Louis, Mo.; Western water-tube boiler. (1898.)  
 Jacob Ruf, Newark, N. J. (1899.)  
 T. W. Rucker, St. Louis, Mo. (1899.)  
 Erdix Rounds, Owensboro, Ky. (1900.)  
 A. L. Rhodes, West Superior, Wis. (1902.)  
 Racine Boat Manufacturing Co., Muskegon, Mich.; Racine water-tube boiler. (1904.)  
 Risdon Iron Works, San Francisco, Cal. (1904.)  
 Risdon Iron and Locomotive Works, San Francisco, Cal. (1910.)  
 Josiah Robinson, Watervliet, N. Y. (1904.)  
 C. M. Raymond steam boiler, the Dieter Steam Engine Co., New York, N. Y. (1905.)  
 Charles G. Rogers, water-tube boiler (modified form Roberts coil boiler), Pittsburg, Pa. (1905.)  
 James J. Rohan, St. Louis, Mo. (1908.)  
 Charles A. Rush, San Francisco, Cal. (1909.)  
 The Shipman boiler, for using petroleum. (1886.)  
 The H. Statesmen boiler, presented by V. R. Hyde, Portland, Oreg. (1886.)  
 James B. Stead, sectional water-tube boilers, Nos. 1 and 3. (1888.)  
 Charles L. Seabury, Nyack, N. Y. (1889, 1891, 1894, 1895, 1897.)  
 See G, Gas Engine & Power Co. and Charles L. Seabury & Co.  
 W. J. Sanderson's, Syracuse, N. Y. (1890.)  
 Harris K. Stroud's, Hastings, Minn. (1890.)  
 Sullivan & Ehler, Albany, N. Y.; McQueen boiler. (1891.)  
 Thomas L. Sturtevant, Boston, Mass. (1891, 1892, 1895.)  
 Shortt Duplex Boiler Co., New York, N. Y. (1892.)  
 W. D. Smith, Detroit, Mich. (1892.)  
 Henry Sutter, Griswold pipe generator and Sutter sectional porcupine boiler. (1893.)  
 Stillman Saunders, Providence, R. I. (1893.)

- Seachrist & Parker, Erie, Pa. (1893.)  
 Lewis Saunders, Lawrence, Mass. (1894.)  
 Lee H. Stevens, New Albany, Ind. (1894, 1895.)  
 B. T. Squier, New York, N. Y. (1895.)  
 William Skelton, jr., Buffalo, N. Y. (1895.)  
 Halcyon Skinner, Yonkers, N. Y. (1895.)  
 Horace See, New York, N. Y. (1895); improvements Nos. 1 and 2 (1904).  
 Jacob H. Smith, Baltimore, Md. (1895.)  
 Isaac E. Shepardson, Providence, R. I. (1896.)  
 Richard Spreckels and Walter J. Wayte, San Francisco, Cal. (1898.)  
 Charles Stillwell, Hampton, Va. (1898.)  
 Wallace Stebbins & Sons, Baltimore, Md. (1900.)  
 The Schaffer Machine and Manufacturing Co., Baltimore, Md. (1902.)  
 George W. Swartz, Decatur, Ala.; porcupine boiler. (1902.)  
 Emil Santsche, Eureka, Cal.; porcupine boiler. (1903.)  
 Salamandrine boiler, manufactured by the Salamandrine Boiler Co., Newark, N. J.; presented by H. L. Ricks, Eureka, Cal. (1903.)  
 Schwing & Greaud, Gramercy, La. (1904.)  
 J. A. Shaw, Newark, N. J. (1904.)  
 Smith patent boiler, presented by E. J. Codd, Baltimore, Md. (1904.)  
 Stickney safety steam generator, H. R. Stickney, Portland, Me. (1905.)  
 Spokane Machinery Supply Co., water-tube boiler. (1905.)  
 Benjamin T. Squier, Brooklyn, N. Y. Towne water-tube boiler. (1906.)  
 Scott Engine and Construction Co., New York, N. Y. Types A and B. (1908.)  
 G. E. Tregurtha, Boston, Mass. (1890, 1892.)  
 Taylor Bros., Trenton, N. J. (1893.)  
 B. Louis Toquet, Westport, Conn. (1893, 1894.)  
 H. H. Taylor, Detroit, Mich. (1895.)  
 Taylor boiler, Detroit Screw Works, Detroit, Mich. (1898.)  
 Taunton Automobile Co., Taunton, Mass.; porcupine boiler. (1903.)  
 Tabrett & Lewin, San Francisco, Cal. (1903.)  
 W. J. Tierney and William Marquez, New Orleans, La. (1895.)  
 Winthrop Thayer, Boston, Mass. (1897.)  
 Thornycroft boiler, Daring and Speedy types. Thorpe, Platt & Co., New York, N. Y. (1897.)  
 Thornycroft boiler, type presented by Newport News Dry Dock and Ship Building Co., Newport News, Va. (1910.)  
 W. M. Towers, Rome, Ga. (1897.)  
 W. C. Thompson, Philadelphia, Pa. (1897.)  
 John Trasher, New Orleans, La. (1902.)  
 William R. Thropp, Trenton, N. J. (1906.)  
 Towne water-tube boiler, presented by Benjamin T. Squier, Brooklyn, N. Y. (1906.)  
 Paul A. Talbot, Seattle, Wash. (1911.)  
 N. A. Uren, Juneau, Alaska. (1907.)  
 Emil Volk, New York, N. Y. (1894.)

J. E. Vincent, Palatka, Fla.; a water-tube boiler and a porcupine boiler. (1902.)

Charles Ward, Charleston, W. Va. (1883); coil boiler and Navy horizontal pipe boiler (1894); Ward's torpedo-boat boiler, Ward's torpedo-boat boiler No. 2, Ward's straight-tube launch boiler (1895); Ward's Royal Arch or Navy boiler (1897).

S. Waterhouse, Boston, Mass. (1884.)

J. W. Walters & Co., sectional water-tube boiler. (1888.)

Wadham, 1315 Third Avenue, New York, N. Y. (1890.)

Worthington water-tube boiler, New York Safety Steam Power Co., New York, N. Y. (1891, 1897.)

George & James Warrington, Chicago, Ill. (1891.)

C. A. Wilkerson, Lynn, Mass. (1892.)

Wickes Bros., East Saginaw, Mich. (1893.)

Warner & Papst, San Francisco, Cal. (1893.)

George L. Wright, North Andover, Mass. (1894.)

Samuel T. Williams, Baltimore, Md. (1894; modification, 1899 and 1900.)

D. Y. Williams, South Haven, Mich. (1894.)

W. Frank West, Morris Heights, N. Y. (1895.)

George Warrington, Chicago, Ill. (1895, 1902.)

Waterous boiler, J. B. Rives, St. Paul, Minn. (1896.)

R. Weston & A. M. Lemke, Saginaw, Mich. (1896.)

George L. Whittington, Sea Isle City, N. J. (1896.)

Charles P. Willard, Chicago, Ill. (1896.)

Benjamin A. Wyatt, Boston, Mass. (1897.)

Charles M. Weber, Cincinnati, Ohio. (1897.)

Watson & Peterson, Kansas City, Mo. (1897.)

Theodore H. Wyman, Sebec, Me. (1897.)

James C. Wignall, Philadelphia, Pa.; Bretherton boiler. (1897.)

Western water-tube boiler; Phil Rohan, St. Louis, Mo. (1898.)

Egbert P. Watson, Elizabeth, N. J. (1898; modification, 1900; porcupine boiler, 1903.)

Robert White, Brooklyn, N. Y. (1899.)

Beder Wood, Moline, Ill. (1899.)

George S. Wolf, West Dover, Ohio. (1901.)

E. C. Walker Co., Louisville, Ky. (1907.)

White patent steam generator, presented by The White Garage, Cleveland, Ohio. (1907.)

Winthrop Waite, New York, N. Y., the Miner flash steam generator. (1907.)

H. T. Wood, Pittsburg, Pa. (1908.)

White-Forster steam generator, The Babcock & Wilcox Co., New York, N. Y. (1909.)

Yarrow water-tube boiler, New York, N. Y. (1892.)

Yarrow type, No. 2, Wm. Cramp & Sons, Philadelphia, Pa. (1897.)

Robert R. Zell & Co., Baltimore, Md. (1894.)

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